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Impact of Natural Gas Shortage on Major Industrial Fuel Burning Installations. Vol III. Appendix: Summary and Analysis of Fuel-Burning Characteristics of MFBIs

Foster Associates, Inc, Washington, D.C. Energy Div.

Prepared for

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IMPACT OF NATURAL GAS SHORTAGE ON MAJOR INDUSTRIAL FUEL-BURNING INSTALLATIONS - VOLUME III. APPENDIX: SUMMARY AND ANALYSIS OF FUEL-BURNING CHARACTERISTICS OF MFBIs

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
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This study was conducted to analyze the impact of natural gas shortages on major fuel burning installations. The analysis consisted of the review of gas curtailments plans, natural gas supplies, FEA survey data for MFBI and applicable state air pollution control regulations. This analysis estimated the availability of natural gas through 1980 for major fuel burning installations, the alternate fuel burning capability of these plants, the need for alternate fuels such as fuel oil and coal to offset the gas shortages and the estimated increase in sulfur dioxide and particulate emissions from the burning of these alternate fuels. The study results are presented in a three volume report: the first contains the narrative for the analysis of natural gas shortages on the gas fired plants with pertinent findings and conclusions; the second contains schedules or data summaries for the natural gas fired plants; and the third presents a limited analysis of all the MFBI data.

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APPENDIX

SUMMARY AND ANALYSIS OF THE FUEL BURNING CHARACTERISTICS OF MAJOR INDUSTRIAL FUEL BURNING INSTALLATIONS

Introduction

In May of 1975 the Federal Energy Administration (FEA) completed a survey of all major fuel burning installations (MFBI) in the United States. This survey was based on an FEA questionnaire entitled: "Major Fuel Burning Installation Coal Conversion Report." The survey, which was collected under the authority granted by the Federal Energy Administration Act of 1974, was designed to aid FEA in carrying out its responsibilities under the Energy Supply and Environmental Coordination Act of 1974. The specific purpose of the survey was to "obtain data required by FEA to examine the feasibility and effect of issuing orders to specified major fuel burning installations prohibiting them from burning oil or natural gas as their primary energy source."

This appendix is a summary and analysis of the FEA MFBI data which was supplied to Foster Associates through the Environmental Protection Agency (EPA). It represents one section of a multi-part study, the purpose of which is to assess the impact of the natural gas shortage on the MFBI. The purpose of the study is to analyze, as the natural gas supply situation deteriorates, which MFBI will be forced to burn alternate fuels in place of natural gas, what alternate fuels will be burned and in what quantities, and what will be the resultant increases in sulfur dioxide and particulate emissions for specific air quality control regions (AQCR) and air quality maintenance areas (AQMA). The MFBI data gathered by FEA represents a major contribution to the overall study; as such detailed information on the industrial sector of the economy has heretofore been unavailable from any source.

ACKNOWLEDGEMENTS

This study was prepared under the direction of John Brickhill by the Energy Division of Foster Associates. Paul Wilkinson acted as assistant task manager and Wayne Mikutowicz acted as technical reviewer for the study. Other technical personnel participating in the preparation of the study were Isobel Bowen, Warren Crane, George Warholic, and Ghislaine Eon.

Without the input of the Energy Strategies Branch of EPA, the chapter dealing with emissions could not have been prepared. Rayburn Morrison and C. Hai Kuo expended considerable effort to provide the necessary data base to Foster Associates. As well, the Federal Energy Administration, Office of Coal Utilization, provided the basic MFBI information pertaining to major combustors and aid with respect to the analysis thereof. We thank John Duan and his staff from that office for their assistance.

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A-2	1-10	Capacity of All Major MFBI Combustors Distributed by Output Classification
A-3	1-13	Total Fossil Fuel Consumption of Major MFBI Combustors in 1974 by AQCR and AQMA
A-4	1-14	1974 Gas Consumption of Major MFBI Gas Combustors Distributed by Primary and Alternate Fuel Capabilities

As previously stated, a questionnaire was to be filed by all MFBI. An MFBI is defined as "an installation or unit other than a power plant[1/] that has or is a fossil-fired boiler, burner, or other combustor of fuel, or any combination thereof at a single site, that has individually or in combination, a design firing rate of 100 million Btu's per hour or greater." Gas turbines and combined cycle or internal combustion engines were excluded by FEA. In addition, this study does not include a few MFBI which do not conform to the typical industrial plant. For example, steam plants and gas turbines operated by electric utilities, and SNG and LNG facilities operated by gas utilities were excluded.

The primary criterion for classifying a plant as an MFBI is thus the total design firing rate (TDFR) of the plant. The TDFR is the sum total of all design firing rates of all combusting devices located at the facility. Individual combustors within an MFBI were classified as "fossil fuel boilers, burners, or other combustors of fuel."

Although all MFBI were required to submit a questionnaire, the most relevant data for the purposes of this study were given only for those individual combustors with a capacity of at least 100 MMBtu/hr. (henceforth termed "major combustors").[2/] With respect to these major combustors, FEA required substantial data pertaining to the coal conversion potential of the combustor and currently installed or necessary pollution control equipment. Moreover, for each of these combustors with a

1/ "A fossil-fuel fired steam electric generating unit that produces electric power for purposes of sale or exchange."

2/ Thus, the pertinent data discussed are available for an MFBI with a TDFR of 100 MMBtu/hr. and only one combustor. It would not be available, however, for an MFBI with a TDFR of 7,500 MMBtu/hr. comprised of 100 combustors each with a capacity of 75 MMBtu/hr.

capacity over 100 MMBtu/hr., FEA required data regarding fuel consumption, primary and alternate energy sources, type of combustor (boiler, burner, or other), and the utilization of the combustor output as between electric generation, space heat, process steam, and other.

It is the latter data which is of particular interest for this study. As discussed in the main body of the text (Volume One) of this study, the ultimate objective is to estimate the future emissions of MFSI as a result of gas curtailments. The FEA data with respect to major gas combustors and their alternate fuel capabilities, coupled with the combustor output, are helpful in assessing the likely priority into which the gas would fall in an end-use curtailment plan. Further, the data with respect to alternate fuel burning capabilities is integral in determining which fuel would be burned if gas were not available, which in turn is critical in estimating resultant emissions.1/ Moreover, the number of large industrial sites and their energy consumption distributed by AQCR and AQMA is of interest to EPA.

It is important to note that the chief concern herein is with gas combustors. The primary data source was a computer printout provided by FEA. However, in some cases a review was made of the original questionnaire in order to acquire additional information and/or to clarify data on the printout regarding gas combustors. No such effort was directed at combustors which did not burn gas.

1/ Natural gas is the cleanest burning of fossil fuels, generally containing negligible sulfur and ash compared to coal or oil.

Certain modest differences exist between the summaries contained herein and a straight tabulation of the FEA data. For example, various refineries reported gas consumption which evidently includes still gas as well as natural gas.1/ Because of the wide variation in the Btu content of refinery gas, and the possibility of mixing refinery gas with natural gas, the Btu content reported was not sufficient to discern which gas was in fact natural gas. Natural gas consumption was therefore estimated for some individual refineries included in this study.

It should also be noted that fuel consumption reported to FEA was not meant to include fuels used as feedstocks -- e.g., natural gas in ammonia, coke in steel. For purposes of this study, it is generally presumed that feedstock gas is not included in the MFBI data. However, FEA has indicated that in some instances coke used as feedstock was included in the coal consumption data.

The summary schedules which follow the text reflect the data collected on approximately 3,400 MFBI. Approximately half of this total are MFBI which include at least one major combustor (capacity in excess of 100 MMBtu/hr.). These plants therefore reported detailed information on combustor capacity, output, fuel consumption, etc., for each major combustor. Those MFBI with at least one major combustor are henceforth termed "major MFBI".

A total of 1,087 major MFBI are natural gas users. That is, 1,087 MFBI have at least one major combustor which burned some gas in either 1973 or 1974. Also included are those MFBI which have major combustors which did not burn gas in 1973 or 1974, but which were built since 1973 and

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1/ The total gas consumption reported by refineries to FEA for some states was substantially greater than refinery consumption of natural gas reported by the Bureau of Mines.

for which gas was listed as the primary fuel. Thus, some 33 percent of all MFBI, and 65 percent of all major MFBI, are major gas burning MFBI.

The 1,087 major gas burning MFBI are the focal point of the overall study. It is for these plants that the natural gas curtailments and resultant increases in alternate fuel consumption and emissions were estimated. Under the direction of FEA all plant-by-plant information is held to be strictly proprietary at this time, and therefore only state and regional summaries are included herein.

Number and Capacity of Major MFBI Combustors

Schedule A-1 shows number and capacity of major MFBI combustors by state, and is based on all combustors with a capacity of at least 100 MMBtu/hr. except those combustors for which the primary fuel was listed as "other". This schedule includes both gas burning and non-gas burning MFBI. All combustors are grouped in four major categories by their primary fuel type: natural gas, residual fuel oil, distillate fuel oil, or coal. The combustors are further sub-divided into three categories by type of combustor: boiler, burner, or other. For each of the resulting 12 categories, the number of combustors and their total capacity in MMBtu/hr. is set out, with the totals of these 12 columns shown in columns (13) through (16). The TDFR of all MFBI is listed in column (17). This TDFR of all MFBI includes the capacity of all combustors at all MFBI, whether the combustor capacity is greater than or less than 100 MMBtu/hr.[1/] The total capacity of all major combustors in the Lower 48 States is 1,055.7 billion Btu/hr., as compared with the sum of all MFBI TDFR's which is

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1/ Thus, column (17) includes capacity of combustors with an "other" primary fuel, small combustors at major MFBI, and non-major MFBI.

2,339.0 billion Btu/hr. Thus, the major combustors for which there is specific and detailed information account for 45 percent of the total capacity of all MWBI. The major combustor capacity as a percent of the total TDFR is relatively uniform for all regions, except Region VI, ranging from 40 to 49 percent. Major combustors in Region VI represent 56 percent of the total TDFR capacity, indicating a somewhat greater percentage of larger combustors in this region.

The total major combustor capacity by region gives a good indication of the geographic distribution of industrial activity in the U.S. Regions V and VI each account for approximately 25 percent of the total U.S. capacity, while Regions III and IV each account for approximately 13 percent. Regions IX and II each account for 6 percent of the total U. S. capacity. The remaining 11 percent is divided among Regions I, VII, VIII and X, with not one of these regions having more than 4 percent of the U.S. total.

The size of major combustors by region varies in a manner quite similar to the distribution cited above. The major combustors in Regions V and VI are the largest, rated at 233 and 232 MMBtu/hr., respectively, as compared with the total U.S. average of 212 MMBtu/hr. Regions III and IV are again comparable, averaging 208 and 201 MMBtu/hr., respectively. The average size is 190 MMBtu/hr. in Region VIII, and 186 MMBtu/hr. in both Regions I and II. The smallest major combustors are located in Regions VII, IX and X, ranging from 178 MMBtu/hr. to 181 MMBtu/hr.

Among the three categories of combustors -- boilers, burners, and others -- the designation of the first is generally clear cut but there is some overlap between burners and others. The classification of burners and others is not entirely consistent among respondents.

A boiler is generally considered to be a device in which a fuel is burned to produce steam. Actually a boiler unit is a facility which has two primary parts: a furnace in which the fuel is burned, and the actual boiler in which the steam is produced. The term boiler is rather common, however, and it is expected that most reporters correctly classified boiler-furnace units as boilers.

The classification of burners and "others" is open to a variety of interpretations, and reporting was probably much less uniform for these categories. A burner is essentially a device for the final release of fuel/air or fuel/oxygen mixtures or air and fuel separately into the combustion zone. In a broad sense, most, if not all combustors could have been classified as boilers or burners. The "other" category is a residual classification. It includes rather unique combustors such as open hearth furnaces, blast furnaces, and kilns. However, these types of combustors were occasionally reported as burners.

In all, there are some 4,981 major combustors as set out on Schedule A-1: 3,405 boilers, 949 burners, and 627 others. The total capacity of these units is 1,055.7 billion Btu/hr.; boilers totaled 709.7 billion Btu/hr., burners accounted for 180.1 billion Btu/hr., and others totaled 165.9 billion Btu/hr. The largest combustors tend to be others, averaging 265 MMBtu/hr. Boilers have an average capacity of 208 MMBtu/hr., while the average burner rating is 190 MMBtu/hr.

Thus -- 68 percent of all major combustors are boilers which account for 67 percent of the total capacity, 19 percent are burners which account for 17 percent of the total capacity, and 13 percent are others accounting for 16 percent of the capacity.

With regard to primary fuel, 2,681 of the 4,981 major combustors are considered to be fueled primarily by gas, 1,068 by residual fuel oil, 123 by distillate fuel oil, and 1,109 by coal. The percentage of total output capacity by primary fuel is: gas = 53 percent, residual fuel oil = 19 percent, distillate fuel oil = 2 percent, and coal = 26 percent. The largest combustors by primary fuel type are coal fired units, with an average capacity of 347 MMBtu/hr. The average gas combustor is rated at 309 MMBtu/hr., as compared with 190 MMBtu/hr. for residual fuel oil and 151 MMBtu/hr. for distillate fuel oil. It is interesting to note that 63 percent of all combustors for which gas is the primary fuel are boilers. This statistic is of particular relevance when analysing gas curtailment plans, as boiler fuel gas usage is generally given a very low priority.

The striking feature of Region I reflected in Schedule A-1 is the overall dominance of residual fuel oil as a primary fuel. A total of 151 of the 138 major combustors in the region are fueled primarily by residual fuel oil, representing 91 percent of the region's major combustor capacity. Of these 123 combustors, 115 are boilers. Eight of the remaining combustors burn gas as a primary fuel, and seven burn distillate fuel oil. Each of these categories represent less than four percent of the region's total major combustor capacity. No major combustors in Region I burn coal as a primary fuel.

The distributional pattern in Region II is similar to that in Region I, although not as extreme. Residual fuel oil is shown to be the primary fuel in 214 of the region's 321 major combustors, accounting for 66 percent of the total capacity. Fifty combustors with 15 percent of the region's

total capacity burn gas as the primary fuel, and 44 combustors with 16 percent of the capacity burn coal. As in Region I, the overwhelming majority of the major combustors in Region II are boilers, as opposed to burners and others. Eighty-seven percent of the major combustors in Region I and 85 percent in Region II are classified as boilers. The burners and others in Region II are located primarily at refineries and chemical plants.

The 630 major combustors in Region III with a total capacity of 121.0 billion Btu/hr. reflect a more even primary fuel distribution than either Region I or Region II. The number of combustors and percent of total capacity by fuel type are: gas - 113 combustors, 17 percent; residual fuel oil - 224 combustors, 30 percent; distillate fuel oil - 22 combustors, 2 percent; coal - 271 combustors, 51 percent.

There are two major differences evident on Schedule A-1 when comparing Region III with Regions I and II. The first is the relative importance of coal in Region III, especially in Pennsylvania and West Virginia where nearly half of the major combustors are fired primarily by coal. The second major difference in Region III is that a greater proportion of combustors are classified as burners and others -- approximately 32 percent of all major combustors. The burners and others are found primarily in the steel mills of Pennsylvania, and also in a few chemical plants, refineries, and glass plants. Of the 113 combustors with gas as a primary fuel, 49 are burners or others accounting for 45 percent of the gas-primary capacity. Again, most of these units are found in the steel mills of Pennsylvania. They are usually heating or reheating furnaces or mills.

There are 682 major combustors in Region IV with a total capacity of 137.3 billion Btu/hr. -- both totals slightly higher than for Region III. Region IV is the first region discussed which exhibits a greater dependence on gas than any other primary fuel in major combustors. Gas is shown to be the primary fuel for 261 of the 682 combustors, while 218 are residual fuel oil fired, 15 are distillate fired, and 188 are coal fired. The capacity distribution by fuel type is: gas - 38 percent, residual fuel oil - 31 percent, distillate fuel oil - 3 percent, and coal - 29 percent. Seventy-five percent of the combustors in Region IV are boilers, while 16 percent are burners and 9 percent are others.

In Region IV 166 of the 261 gas fired combustors are boilers. These boilers account for 61 percent of the capacity of all gas fired combustors, while burners and others represent 25 percent and 14 percent respectively. The burners and others are again in the steel mills, refineries, and chemical plants. There are also a number of cement kilns reported in Region IV.

Region V is the second largest and most diversified region in terms of major combustors. There are some 1,133 major combustors in Region V with a total capacity of 263.5 billion Btu/hr. This capacity is distributed more or less evenly between coal fired and gas fired combustors, and there is also a significant amount of fuel oil burned in Region V. There are 496 gas fired combustors in Region V with 39 percent of the total capacity, 154 residual fuel oil combustors with 12 percent of the capacity, 39 distillate fuel oil combustors with 2 percent of the capacity, and 444 coal fired combustors with 47 percent of the capacity.

Boilers accounted for 802 of the 1,133 major combustors in the region and 60 percent of the total capacity. Burners and others numbered 230 and 101 respectively, accounting for 40 percent of the region's total capacity. These burners and others thus represent a larger proportion of the total capacity in Region V than is true for the nation as a whole. For the total U.S., 67 percent of all capacity is boiler capacity, and 33 percent is burner and other capacity. The burners and others in Region V again reflect the industrial diversity of the area, as they are found in steel mills, refineries, chemical plants, automobile plants, cement plants, and others. The numerous steel mills account for the lion's share of these combustors.

In terms of major combustors and their capacities Region VI is quite comparable to Region V, with the totals for Region VI being slightly larger in each case. There are 1,200 major combustors in Region VI with a total capacity of 278.4 billion Btu/hr, as compared with 1,133 major combustors in Region V with a capacity of 263.5 billion Btu/hr. These two regions account for over half of the total major combustor capacity in the U.S. There is a fundamental difference between the two regions, however, as evidenced by the distribution of combustors by fuel type. The combustor capacity in Region V is distributed more or less equally between gas and coal, and a significant amount of residual fuel oil is also burned. In contrast, natural gas totally dominates the distribution in Region VI where 1,137 combustors are gas fired, accounting for 94 percent of the overall capacity in the region.

A total of 726 of the nation's 1,687 gas fired boilers are located in Region VI (434 in Texas and 221 in Louisiana). In addition, 411 of the total 994 gas fired burners and others are in Region VI. The gas fired combustors in Region VI account for 47 percent of the total U.S. gas fired capacity.

Sixty-four percent of the gas fired combustors in Region VI are boilers, 31 percent are burners, and 15 percent are others. The burners and others are located mainly in the refineries, chemical plants, and some cement plants. Over 42 percent of the total U.S. crude oil refinery capacity is located in Region VI. Units within refineries classified as burners or others include crude oil heaters, reheavers, and reformers.

There are 193 major combustors in Region VII with a total capacity of 31.4 billion Btu/hr. Sixty-two percent of the major combustors in Region VII are fueled primarily by gas, 28 percent by coal, five percent by residual fuel oil, and five percent by distillate fuel oil. Seventy-eight of the 120 gas fired combustors in Region VII are boilers, 16 are burners, and 26 are others. The burners and others are found in a few refineries, and also a number of cement and lime plants.

Region VIII, similar to Region VII, is a relatively small region in terms of major combustors. There are 199 major combustors in the region with a total capacity of 37.8 billion Btu/hr. The breakdown by primary fuel type is also similar: 51 percent of the plants are gas fired, 19 percent are oil fired and 30 percent are coal fired. Of the 101 gas

fired combustors, 66 are boilers and 35 are burners and others. The burners and others are listed for a variety of industries: cement, steel, sugar, asphalt, and copper.

Region IX contains 324 major combustors with a capacity of 58.5 billion Btu/hr. This region is of small to moderate size in terms of major combustors. California accounts for nearly 90 percent of the region's capacity. The strict air quality standards in California are reflected by the heavy concentration of gas fired combustors as indicated on the schedule. In all, 267 of the 288 California major combustors with over 91 percent of the state's total capacity burn gas as a primary fuel. The gas primary combustors include 134 boilers and 133 burners and others. California is a major crude oil refining state, second only to Texas in terms of crude capacity with nearly 13 percent of the total U.S. capacity. Thus, the majority of the burners and others in California are found in refineries. There are also numerous cement and asphalt plants in California; cement plants usually listing kilns as others, and asphalt plants indicating many burners.

There are 161 major combustors in Region X: 104 gas fired, 18 residual fuel oil fired, 7 distillate fuel oil fired, and 32 coal fired. The region's total capacity of 39 billion Btu/hr. is derived 67 percent from gas, 13 percent from residual fuel oil, 4 percent from distillate fuel oil, and 16 percent from coal. Twenty-six of the 104 gas fired combustors are burners or others which are found mainly in cement and sugar plants. There are also three small refineries in Washington.

Capacity of Major MFBI Combustors Distributed by Output Classification

Schedule A-2 sets out the capacity in MMBtu/hr. of major MFBI combustors by output classification. Included in the schedule are the data for all major combustors (capacity in excess of 100 MMBtu/hr.) except those for which the primary fuel is "other". The respondents to the FEA survey were asked to indicate the percent of each major combustor's output which was devoted to electric generation, space heat, process steam, and other. Schedule A-2 reflects these data on a state basis, arranged by primary fuel type (natural gas, residual fuel oil, distillate fuel oil, and coal), and combustor type (boiler, burner, and other). The capacity distributions in Columns (13) through (15) represent the sums of Columns (1) through (12) by combustor type. Column (16) is the total capacity of all major combustors, and therefore is equal to the sum of Columns (1) through (12), and also Columns (13) through (15). It should also be noted, the total capacity for each state in Columns (1) through (16) is identical to the state total set out on Schedule A-1, Columns (1) through (16), since the same combustors are treated.

The capacity of each combustor has been weighted by the four output categories. That is, if the output of a combustor with a capacity of 150 MMBtu/hr. was classified as 75 percent process steam and 25 percent "other", an entry of 112.5 MMBtu/hr. was made in a process steam grouping, and 37.5 MMBtu/hr. was placed in an "other" grouping.

The total capacity of all major KFBI combustors in the lower 48 States is 1,055.7 billion Btu/hr. Of this capacity, 9 percent is devoted to electric generation, 8 percent to space heat, 49 percent to process steam, and 34 percent to "other".

The respondents were asked to clarify any output classified as "other", but this clarification does not appear on the FEA printout. A review was therefore made of selected questionnaires in order to make a general appraisal of the "other" category. The questionnaires revealed that nearly all output classified as other was some type of process heating. The majority of the other output occurs in the steel mills and crude oil refineries, where tremendous amounts of process heat are required. For example, there are numerous heating and reheating applications in the steel industry. The calcination of limestone to lime is another example of process heating which usually falls in the other output group. This calcination procedure is prevalent in the cement and glass industries, and may also be used in the copper, ammonia, and aluminum industries.

Perhaps the primary point reflected by Schedule A-2 is that the output of boilers is substantially different from the output of burners and others (as previously mentioned there is some overlap in the classification of burners and others). Approximately 70 percent of all boiler fuel capacity is devoted to process steam, whereas only 3 percent of burner capacity and 7 percent of other capacity is used for process steam. On the other hand, 93 percent of burner capacity and 91 percent other capacity is used for other output, but only 5 percent of boiler capacity is shown as other.

Electric generation and space heat each account for approximately 12 percent of boiler capacity, while less than 2 percent of burner and other capacity is so designated. Thus, the output of boilers is primarily devoted to process steam with some relatively small but significant electric generation and space heating applications. Burners and others, however, are used almost exclusively for other output.

There is some variation in output classification by primary fuel type for boilers, but much less variation occurs for burners and others. Gas fired boilers, accounting for 155.0 billion Btu/hr. of the 709.7 billion Btu/hr. total boiler capacity have a capacity utilization of 77 percent for process steam. The capacities and process steam usage for the remaining boilers are: residual fuel oil fired - 162.8 billion Btu/hr., 67 percent; distillate fuel oil fired - 10.5 billion Btu/hr., 57 percent; and coal fired - 181.4 billion Btu/hr., 59 percent. Thus, the distillate fuel oil fired and coal fired boilers are devoted somewhat less to the production of process steam than are gas fired and residual fuel oil fired boilers. The generation of electricity accounts for a greater portion of the coal fired output capacity than all boilers fired by other primary fuels (22 percent vs. 10 percent), while distillate fuel oil boilers are used relatively more than other boilers for space heating (35 percent vs. 11 percent).

The output distributions by primary fuels show little variation from the norms for burners and others. One modest difference is that over 99 percent of all coal fired burner capacity falls in the other category, as opposed to 9; percent for all other burners.

The following table sets out the percentage distribution of major MFBI combustors by output classification and EPA region.

PERCENTAGE DISTRIBUTION OF MAJOR COMBUSTOR CAPACITY BY OUTPUT CLASSIFICATION

EPA Region	Electric Generation	Space Heat	Process Steam	Other	Total
I	13%	17%	55%	15%	100%
II	8	15	51	26	100
III	10	13	43	34	100
IV	8	7	61	24	100
V	11	14	34	41	100
VI	8	1	63	28	100
VII	6	7	48	39	100
VIII	16	6	35	43	100
IX	6	1	40	53	100
X	5	11	60	24	100
Total Lower 48 States	9%	8%	49%	34%	100%

This table again indicates that Regions I and II are somewhat similar in terms of MFBI data. The percent of output capacity used for space heating is relatively high for both of these regions, while other use is relatively low. The other output in Region I is the lowest in the U.S., reflecting the fact that there is very little refinery or steel making activity in the region. The other category is also low in Region II, although substantially higher than in Region I. The other output in Region II is mainly attributable to a number of refineries in New Jersey and a number of asphalt and steel works in New York.

Region III is quite comparable to the overall U.S. average with regard to the distribution of its output capacity. The other output in Region III is attributable to the heavy concentration of steel mills in Pennsylvania, and also a number of scattered refineries and asphalt plants.

Sixty-one percent of all major combustor capacity in Region IV is used to produce process steam, as opposed to 49 percent for the total U.S. This concentration in the process

steam category is the result of two factors. First, a very high percentage of overall capacity is boiler capacity in Region IV - 76 percent vs. 67 percent for the total U.S. (as previously pointed out, boilers tend to have a high process steam output). And second, the boilers in Region IV are even more process steam oriented than all boilers - 77 percent of total capacity vs. 70 percent for the total U.S. The 33.2 billion Btu/hr. of other capacity in Region IV may be traced to a number of industries: steel, cement, paper, chemicals, asphalt, and refineries.

In contrast to Region IV, Region V has a relatively low percentage of output capacity tied to process steam, and a relatively high percentage tied to the other category. As shown on Schedule A-2, only 91.3 billion Btu/hr. of the total 263.5 billion Btu/hr. is used to produce process steam in Region V. This represents some 34 percent of total capacity as opposed to nearly 50 percent for the total U.S. The reason Region V has the lowest percentage in the process steam category of all EPA regions may be due to the industrial structure of the region. Only 60 percent of the total capacity in Region V is boiler capacity, as opposed to 67 percent for the total U.S. The relatively high percentage of output capacity devoted to the other category is again an indication of the region's many diverse and complex industries -- steel, refining, glass, chemicals and cement. Further, it appears that coal fired boilers tend to be used less than gas and residual fuel oil fired boilers for the production of process steam. In Region V, 47 percent of all boilers use coal primarily, and 51 percent burn gas or residual fuel oil. The figures for the total U.S. are 35 percent and 73 percent, respectively.

Although Regions V and VI are quite comparable with regard to their capacity magnitude, Schedule A-2 indicates

substantial differences in composition. Whereas Region V has a relatively high percentage of output capacity classified as other and a relatively low percentage classified as process steam, the results for Region VI are just the opposite. Sixty-three percent of all output capacity is process steam in Region VI, and only 30 percent is other. The percentage of capacity used for process steam in Region VI is higher than in any other region. This could be expected since 70 percent of all combustors in Region VI are boilers (60 percent in Region V). Although the percentage of total capacity classified as other in Region VI is relatively low, in absolute terms it is very large. In fact, the 78.4 billion Btu/hr. capacity used for other in Region VI is second only to Region V, and represents 33 percent of the other capacity in the U.S. The other capacity in Region VI covers a variety of industries -- refining, cement, asphalt, chemicals, sugar, steel and other primary metals.

The capacity distributions for Regions VII and VIII are not substantially different from the total U.S. distribution. The other percentage is somewhat high for both regions, resulting primarily from a number of cement and asphalt plants and also a few refineries.

Of the total capacity in Region IX (58.5 billion Btu/hr.) 40 percent is used to produce process steam (23.4 billion Btu/hr.), and 53 percent is categorized as other (31.1 billion Btu/hr.). The relatively low process steam output stems from the fact that only 47 percent of the Region's total capacity is derived from boilers. The other output is primarily the result of the heavy concentration of refineries, cement, and asphalt plants in California.

The total capacity in Region X is 29.2 billion Btu/hr. Of this amount, 22.2 billion Btu/hr, or 76 percent exists as boilers, and 82 percent of this boiler capacity is fueled primarily by gas or residual fuel oil. A relatively high (60 percent) portion of the Region X capacity is used to generate process steam. The other output in Region X is attributable to a number of sugar and cement works in the area.

Total Fossil Fuel Consumption of Major MFBI Combustors in 1974 by AQCR and AQMA

Schedule A-3 sets out the total energy consumption of major MFBI combustors by EPA region, state, AQCR and AQMA. The 1974 consumption in billions of Btu is shown for natural gas, residual fuel oil, distillate fuel oil, and coal. (Note: All AQMA data are slightly indented on the schedule and preceded by a dash. Each state total is equal to the sum of the component AQCR since all MFBI are located within AQCR's, but the state and AQCR totals do not necessarily equal the sum of the AQMA's since not all MFBI are located within AQMA's). An attempt was made to exclude any gas other than natural gas which was included in the MFBI data. No such attempt was made to segregate coke from the coal data, although it is apparent that some coke has been included.

The total fossil fuel consumption by major MFBI combustors in 1974 was 5,623.3 trillion Btu. The distribution by fuel type was as follows: gas = 2,870.7 trillion Btu (51 percent); residual fuel oil = 1,107.8 trillion Btu (20 percent); distillate fuel oil = 69.3 trillion Btu (1 percent); and coal = 1,575.1 trillion Btu (28 percent).

The major MFBI totals set out above may be compared with the total industrial energy consumption as reported for

1974. Total industrial energy consumption in 1974 was 12,086.6 trillion Btu distributed as follows: gas - 8,704.0 trillion Btu (68 percent); residual fuel oil - 2,053.5 trillion Btu (16 percent); distillate fuel oil - 449.2 trillion Btu (3 percent); coal - 1,578.1 trillion Btu (12 percent); and LPG - 101.8 trillion Btu (1 percent).

Thus, the total energy consumed by major MFBI combustors was 44 percent of the total industrial energy consumption. It is interesting to note that major combustors also account for 45 percent of the total combustor capacity of all MFBI. Natural gas consumption by major MFBI combustors was 33 percent of the total U. S. industrial gas consumption, while residual fuel oil and distillate fuel oil reported in the MFBI data were 54 percent and 15 percent of the industrial totals. Coal consumption reported for major MFBI combustors was over 99 percent of the total U. S. industrial coal consumption.

The fact that major MFBI coal consumption equaled the total 1974 industrial coal consumption, and that coal accounted for 28 percent of the major MFBI total energy consumption as opposed to 12 percent of the total industrial coal consumption, suggests two things. First, there are obviously some errors in the MFBI coal reporting. This suspicion is confirmed by the fact that MFBI consumption exceeded actual consumption in Regions III, VIII, and IX. No attempt was made to exclude coke reported as coal, as this study is primarily a natural gas study. A second possible explanation for the high coal coverage is that coal combustors tend to be larger than other combustors, as is discussed in the section describing Schedule A-1, wherein it is stated that the average coal combustor is rated at 247 MMBtu/hr. Since consumption is shown only for large combustors (capacity of at least 100

MMBtu/hr.), it should be expected that a relatively high percentage of coal combustors would be included in the MFBI survey.

In contrast to coal, the gas reported with the MFBI data seems somewhat low. Gas accounts for 51 percent of total major MFBI energy consumption, versus 69 percent of total industrial energy consumption. Approximately 33 percent of all industrial gas consumption is included in the MFBI consumption, as opposed to 44 percent for all fuels. (It should be remembered that a decrease in the coal quantity shown would increase the relative share of the natural gas contribution to MFBI energy consumption, and would also decrease the 44 percent figure of MFBI total consumption as a percent of total industrial consumption). One reason for a lower gas coverage is that gas combustor tend to be smaller than coal combustors. While there are certain economies of scale available to large coal combustors, the same may not be as applicable for gas combustors. Gas is an economically feasible fuel for the largest industrial boiler or the smallest home heating furnace. A second explanation for the lower gas coverage is the fact that feedstock fuels were not reported. Thus, substantial quantities of gas used in a variety of industrial processes are not included.

The contribution of oil to total major MFBI energy consumption in 1974 was 21 percent, essentially the same as was reported for total industrial energy consumption. The breakdown for the MFBI sample was 20 percent from residual fuel oil and 1 percent from distillate fuel oil, while it was 16 percent and 3 percent respectively for the total industrial consumption data. Total oil consumption from the

MFBI sample was 47 percent of actual industrial oil consumption -- 54 percent coverage for residual fuel oil and 15 percent for distillate fuel oil. It should be expected that the coverage for residual fuel oil would be better than for distillate fuel oil, since residual combustors average 190 MMBtu/hr. and distillate combustors average only 151 MMBtu/hr. Distillate combustors are the smallest of all combustors, and their minimal coverage in the MFBI survey reflects this fact.

The following table sets out the distribution of fuel consumption by major MFBI combustors, and also the distribution of total industrial energy consumption. The second table indicates the percent of actual industrial consumption accounted for by the MFBI data by fuel type.

1974 Gas Consumption of Major MFBI Gas Combustors
Distributed by Primary and Alternate Fuel Capabilities

Schedule A-4 depicts the gas consumption of all major MFBI combustors in billions of Btu for the year 1974. The data are set out by EPA region, state, AQCR and AQMA. (Note: All AQMA data are slightly indented on the schedule and preceded by a dash. Each state total is equal to the sum of the component AQCR's since all MFBI are located within AQCR's, but the state and AQCR totals do not necessarily equal the sum of the AQMA's since not all MFBI are located within AQMA's.)

The gas consumption data of each major combustor are set out in one of nine categories shown on Schedule A-4. There are 2 major categories on the schedule and 9 sub-categories. Any gas which was consumed in a combustor for which the primary fuel is gas was entered in columns 1 through 5. The particular column in which the gas appears depends on which fuel the respondent listed as being an alternate for gas: residual fuel oil, distillate fuel oil, coal, other, or no alternate. Any gas which was consumed in a combustor for which the primary fuel is not gas is shown in columns 6 through 9. This gas is classified according to the primary fuel of the combustor: residual fuel oil, distillate fuel oil, coal, or other. The primary and alternate fuel capabilities of the combustors were taken directly from the FEA printout as indicated by the respondents. Some changes were made if an error was suspected; e.g., if the respondent listed the primary fuel as gas for a combustor operating on some type of gas other than natural gas (refinery gas, propane, etc.) the primary fuel was changed to other. Further, any gas consumption indicated by the respondents

which did not appear to be natural gas was not included in the schedule. Substantial revisions were made involving a number of refineries, especially in Region V and in California, for which various still gases were apparently included with natural gas consumption data.

The total natural gas consumption of all major MFBI combustors in 1974 was 2,870.7 trillion Btu. The 1974 industrial gas consumption (both firm and interruptible) for the Lower 48 States according to the Gas Requirements Committee was approximately 8,703.7 trillion Btu. Thus, those combustors with a capacity of at least 100 MMBtu/hr. within MFBI accounted for some 33 percent of all industrial gas consumption. The following table sets out the MFBI regional gas consumption as a percent of the GRC industrial total, and also the percent distribution of MFBI total consumption by region and the percent distribution of GRC consumption by region.

EPA Region	Gas Consumption of Major MFBI Combustors as a Percent of FRC Total Industrial Gas Consumption	Percent Distribution of Industrial Gas Consumption by EPA Region	
		MFBI Data	GRC Data
I	10%	0.3%	0.6%
II	12	0.7	3.1
III	17	3.2	6.3
IV	27	8.8	10.8
V	27	15.9	19.1
VI	40	54.0	44.4
VII	22	3.1	4.6
VIII	23	3.6	3.3
IX	33	7.5	7.8
X	44	3.0	2.2
Total Lower 48 States	33%	100.0%	100.0%

Schedule A-4 indicates that 90 percent of all major combustor gas consumption in 1974 took place in gas primary

combustors -- 2,588.9 trillion Btu. The alternate fuel for 643.9 trillion Btu (23 percent of all gas consumed) was residual fuel oil, while the alternate for 438.1 trillion Btu (15 percent of all gas consumed) was distillate fuel oil. Coal and "other" alternates each backed up some 4 percent of the total gas consumption, 121.1 and 120.3 trillion Btu respectively. Forty-four percent (1,265.8 trillion Btu) of all gas consumption was in combustors for which the respondents felt there was no alternate to gas as an energy source.

Ten percent of the total gas consumption (281.8 trillion Btu) was in combustors for which gas is not the primary fuel. Approximately 3 percent of all gas consumed (87.9 trillion Btu) was an alternate for residual fuel oil, 2 percent (70.6 trillion Btu) was an alternate for coal, 4 percent (117.2 trillion Btu) was an alternate for "other" fuels, and less than 1 percent (6.1 trillion Btu) was consumed as an alternate for distillate fuel oil.

The summary results quoted above show significant changes when Region VI is excluded from the computations. The natural gas situation in Region VI differs substantially from other regions, and the weight of Region VI (54 percent of the total MFBI consumption) tends to distort the picture of the total U.S. Region VI includes Texas and Louisiana, the two largest industrial gas consuming states in the Nation. It is also the area where most U.S. natural gas is produced, both offshore and onshore. Further, a good portion of the gas consumed in Region VI is transported through intrastate pipelines, and therefore is not subject to regulation by the Federal Power Commission. These factors, as well as others, result in a gas consumption pattern quite different from the other 9 regions.

The ratio of gas consumed as a primary fuel to gas consumed as an alternate fuel when Region VI is excluded from the total U.S. drops from 90/10 to 80/20. Further, the amount of gas consumed which had no alternate fuel drops from 44 percent of the total consumed to 14 percent (1,265.8 trillion Btu to 183.6 trillion Btu). Also, the percentage of gas consumed with an oil alternate (both distillate and residual fuel oil) increases from 37 percent to 55 percent. Total gas consumption excluding Region VI drops from 2,870.7 trillion Btu to 1,321.2 trillion Btu.

Region I is the only region in which the majority of the gas consumed in 1974 was burned as an alternate fuel. A relatively minor 5.5 trillion Btu was supplied by gas in Region I, 3.7 trillion Btu as an alternate for residual fuel oil and 1.8 trillion Btu as a primary fuel with a residual fuel oil alternate. All gas consumed in Region I could have been replaced by fuel oil -- 98 percent by residual and 2 percent by distillate.

The 20.8 trillion Btu supplied by gas in Region II accounts for less than 1 percent of the total MFBI gas consumption. Of this amount approximately 19 trillion Btu was consumed as a primary fuel, including 13.1 trillion Btu with a residual fuel oil alternate and 4.2 trillion Btu with no alternate. The gas was consumed with no alternate and the gas consumed as an alternate fuel for "other" was burned primarily in the refineries of New Jersey.

Total gas consumption in Region III was 91.9 trillion Btu in 1974 -- 59.1 trillion Btu as a primary fuel and 32.8 trillion Btu as an alternate fuel. A portion of the gas

consumed in Region III, equivalent to some 15.7 trillion Btu, was shown as having no alternate. Eighty percent of this gas was burned in the steel mills, refineries, and asphalt plants of Pennsylvania.

Region IV was the third largest region in terms of 1974 MFBI gas consumption, falling behind Regions VI and V in this respect. Seventy-five percent of the region's total gas consumption of 253.5 trillion Btu was considered to be primary fuel consumption. Sixty-one percent of the Region IV consumption was tied to oil (either residual or distillate fuel oil) -- 125.6 trillion Btu as a primary fuel and 28.9 trillion Btu as an alternate fuel. Thirty-one trillion Btu of gas was shown as having no alternate -- 70 percent of which is attributable to the refineries and chemical plants in Mississippi.

The quantity of MFBI gas consumed in Region V was second only to the Region VI consumption. A total of 456.6 trillion Btu was burned in 1974, 80 percent of which was considered to be the primary fuel. Over half of the gas listed as a primary fuel consumed in Region V had an oil backup -- 169.7 trillion Btu in the form of residual fuel oil and 69.7 trillion Btu in the form of distillate fuel oil. Coal backed up an additional 49.3 trillion Btu, while 26.3 trillion Btu had an other alternate and 56.3 trillion Btu had no alternate. The majority of the gas burned with no alternate involved the steel industry, while chemical, asphalt, and automobile plants also played a part.

The total consumption in Region VI was 1,549.5 trillion Btu. This was greater than in all other regions combined. Over 90 percent of this gas was consumed in the States of Texas

and Louisiana. The startling contrast between Region VI and the remainder of the Lower 48 States is that 70 percent of all gas consumed in Region VI was shown as having no alternate, while only 14 percent of all gas in other regions was so classified. Part of this contrast might be explained by reporting techniques, since no elaboration of the term "alternate fuel" was provided on the questionnaire. It is, therefore, unclear whether alternate fuel capability refers to the combustor's capability with no modification, with minor modifications, or with substantial alterations to the unit. However, the major difference stems from the fact that most combustors in Region VI were constructed under the assumption that natural gas would continue to be an abundant and relatively inexpensive fuel. Combustors in this region were, therefore, specifically designed to burn gas, and the utilization of other fuels may be technically impossible, or at least economically unfeasible in these combustors.1/

Ninety-eight percent of the gas consumed in Region VI was considered to be a primary fuel, totaling some 1,520.0 trillion Btu. Residual fuel oil was listed as an alternate for 10 percent of this gas, and distillate fuel oil was an alternate for 14 percent of the total.

Total consumption in Regions VII and VIII was 87.7 and 103.9 trillion Btu respectively. Each of these regions accounted for roughly 3 percent of the total MFBI gas consumption. Eighty-eight percent of the gas consumed in Region VII

1/ For a discussion of the problems involved in converting a gas-fired boiler to a coal or oil-fired boiler, see The Impact of Natural Gas Curtailments on Electric Utility Plants prepared for RPA by Foster Associates in August of 1975. A more detailed discussion of this subject is contained in a report of the Fort Worth Regional Office of the FPC: "The Phasing Out of Natural Gas and Oil for Electric Power Generation," Sept. 1975.

was considered to be the primary fuel, and 75 percent in Region VIII. Residual fuel oil was listed as the alternate fuel for 30 percent of the gas burned as the primary fuel in Region VII and 38 percent in Region VIII, while distillate fuel oil was the alternate for 17 percent of this gas burned in Region VII and 14 percent in Region VIII. Nearly 17 trillion Btu of gas was shown as having a coal alternate in Region VII, mainly attributable to the cement industry.

Region IX accounted for just over 7 percent of the total MFBI gas consumption in 1974, approximately 215.8 trillion Btu. This gas consumption was heavily concentrated in the State of California -- 185.7 trillion Btu -- which ranks only behind Texas and Louisiana in terms of MFBI gas consumption. There is a good deal of substitutability between oil and gas in California, as reflected by the fact that 68 percent of all gas burned had an oil alternate. Some 40.5 trillion Btu consumed in California had no alternate, and again most of this consumption occurred in the refineries.

The 85 trillion Btu of gas burned in Region X equals approximately 3 percent of the U.S. total, and 96 percent of the gas consumed was considered to be the primary fuel. Some 82 percent of all gas consumed was backed up by distillate and residual fuel oil alternates.

Special Industry Analyses

EPA has requested that the MFBI data for two industry groupings be analyzed. Set out below are analyses for the glass and iron and steel industries.

The Glass Industry

The U.S. Department of Commerce estimates that natural gas consumption in all segments of the glass industry exceeded 300 billion cubic feet in 1974. One half of that amount is attributable to the glass container segment (SIC 3221) with most of the balance being shared equally by flat glass (SIC 3211) and pressed and blown glassware (SIC 3229).

The MFBI data include at least nineteen plants with major combustors that are associated with the glass industry. Most of the plants are located in the North Central and Mid Atlantic states although a few are located in the South and Far West. Fifteen of the plants manufacture flat glass, two manufacture products of purchased glass (SIC 3231), one is only partially involved in manufacturing glass containers, and one is classified in the auto industry, but is known to manufacture automobile windshields. The largest energy consuming segment of the industry, glass containers, is not adequately represented presumably because there are many plants with relatively small combustors. Approximately one-half the number of flat glass plants reported by the Department of Commerce are MFBI with major combustors. The major combustors at these flat glass plants consumed over 34 billion cubic feet of natural gas in 1974. This represents over half of the total (SIC 3211) consumption estimated by the Department of Commerce.

There are 39 major combustors in the 19 glass plants. Of these, 12 are boilers, none are burners and 27 are classified as "others". Although 12 of the MFBI have boilers, the 12 boilers qualifying as major combustors are located in 4 plants. The output of every boiler is at least 50 percent process steam, while the output of 8 of the boilers produce more than 90 percent process steam. All 12 boilers are used for space heating, which accounts for 3 to 10 percent of boiler output, in every case. Six boilers are used to generate electricity. The output of one boiler is 45 percent electricity, while 3 others generate 30 percent electricity.

The primary fuel for every major combustor is natural gas. All 12 boilers listed gas as the primary fuel and residual as the alternate fuel. Fourteen other combustors had distillate as the alternate fuel, 4 had residual, 3 had propane and 6 had no alternate. None of the combustors had coal as an alternate fuel. Every flat glass combustor that showed no alternate fuel capability was built prior to 1960. This indicates that newer combustors are being designed with alternate capabilities.

All but one MFBI have the same primary and alternate fuel for every combustor, the exception being one plant that has no alternate fuel capability in an old combustor, and distillate capability in a newer combustor. The fuel mix tends to be the same at different plants owned by the same parent company (2 parent companies owned 13 of the plants). Only 4 plants listed residual as an alternate. These 4 plants have boilers and are all owned by one parent company. Another company owns 7 plants and always lists distillate as the alternate fuel. No regional pattern is apparent. Thus,

it seems likely that the choice of an alternate to gas depends on individual plant technology and the views of company management.

On a Btu basis, natural gas accounted for approximately 93 percent of all fuels consumed by the major combustors in 1974. Distillate accounted for 4 percent and residual 3 percent. There was no coal consumed. This overstates the dependence on natural gas because the total consumption includes only gas, residual, distillate and coal and excludes "other" fuels such as propane or coke. Boilers represent one-third of the rated capacity of the major combustors but account for less than one-fifth of the Btu consumed in 1974. Obviously, the "other" combustors are running at a higher level of utilization than boilers, although this could be misleading because all of the boilers belong to one parent company. Natural gas accounts for 80 percent of boiler fuels and 95 percent of fuels for "other" combustors. It appears that "other" combustors are more dependent on natural gas than boilers, because their application is more specific.

Most of the output from the major combustors in glass production is probably used to melt the raw materials (soda ash, glass sand, feldspar, limestone, salt cake, and reused glass or cullet). The flame is situated above the raw materials in the melting furnace. Because of this, a fuel such as coal would be difficult to use. The quality of glass is increased by the amount of time it is "soaked" by heat.

Manufacturers of flat glass and other high quality glass increase the soak time to remove air bubbles and other impurities. It is important to note that fuels other than natural gas and propane add increasing amounts of impurities to the operation and could presumably increase soak times. Since most flat glass operations are large, with long soak periods and producing long sheets, there is a need for continuous furnaces. These would probably be of a size large enough to be considered major combustors. Glass container operations, on the other hand, require less soaking time and can use small "gobs" of glass at a time. Consequently, the furnaces are not as large although several glass container plants are listed in the MFBI survey.

Other possible uses of outputs from the major combustors are refinements on the finished product such as tempering, annealing, polishing and cutting.

The production of soda ash requires substantial amounts of energy. Because the glass industry is the largest consumer of soda ash, soda ash production is often closely tied to glass plants. However, from an analysis of the data, it appears soda ash production was listed separately in the MFBI data under SIC 2812 and is not dependent on natural gas.

The Iron and Steel Industry

As defined in this industry analysis the Iron and Steel industry includes blast furnaces, steel works, and rolling mills (SIC 3310) and iron and steel foundries (SIC 3320). The

1974 Directory of Iron and Steel Works of the United States and Canada[1] identifies approximately 175 companies (excluding subsidiaries) having domestic iron and steel works. The MFBI data contain only 32 parent companies operating in iron and steel industry. The majority of the 133 companies listed by the American Iron and Steel Institute (AISI) are manufacturers of pipe, wire, and other specialty products. These firms are not adequately represented in the MFBI data, presumably because these plants contain relatively small combustors.

The MFBI data include 102 plants with major combustors. The majority of these plants (more than 76 percent) are located in EPA Regions III and V. However, every EPA Region contains at least one iron and steel MFBI.

Of the 102 plants containing major combustors, 47 contained only combustors which consumed some natural gas in 1973 or 1974. These combustors are classified as major gas combustors.[2] An additional 26 plants contained both major gas combustors and non-gas combustors, while 29 plants contained only non-gas combustors.

The U.S. Department of Commerce estimated that natural gas consumption in the primary iron and steel industry was 673.9 billion cubic feet in 1974. Almost 90 percent of this consumption was attributed to blast furnaces and basic steel production, while the remainder was consumed by iron and steel foundries.

1/ American Iron and Steel Institute, Directory of Iron and Steel Works of the United States and Canada, 1974.

2/ A major gas combustor is a combustor with a design firing rate of 100 MMBtu/hr, or greater, which burned gas in either 1973 or 1974.

The major combustors in the iron and steel industry contained in the MFBI data reported gas consumption in 1974 at 451.0 billion cubic feet. This represents more than 67 percent of the total gas consumption estimated by the Department of Commerce.

The total design firing rate (TDFR) of the iron and steel plants reported in the MFBI data is 428,366 MMBtu/hr. The TDFR includes both the major fuel combustors and combustors rated at less than 100 MMBtu/hr. at MFBI. This accounts for 18.3 percent of the TDFR of all MFBI in the industrial sector. A comparison of the capacity of major combustors in the iron and steel industry with the major combustors of the total industrial sector indicates 27.7 percent of the major combustor capacity is associated with iron and steel operations. This seems to indicate that the combustors in the iron and steel industry are predominantly major combustors.

Combustor Characteristics of the Iron and Steel Industry

Classification of Combustors: The 102 plants in the iron and steel industry reported a total of 897 major combustors with an associated capacity of 294,268 MMBtu/hr. The table below sets out the number and capacity of these combustors. For combustors as a group, the capacity is about evenly distributed among boilers, burners and others. However, when the major gas combustors are considered alone it can be seen that 41.5 percent of this capacity is represented by boilers. In the case of the non-gas combustors, the "others" classification

accounts for 48.6 percent of the capacity. In the aggregate, the average capacities of boilers, burners, and others are 284, 250 and 574 MMBtu/hr., respectively.

IRON AND STEEL INDUSTRY MAJOR COMBUSTORS
BY CLASSIFICATION

	Major Gas Combustors		Major Non-Gas Combustors		Total	
	Number	Capacity (MMBtu/hr.)	Number	Capacity (MMBtu/hr.)	Number	Capacity (MMBtu/hr.)
Combustor Classification						
Boilers	332	58,445	118	37,904	340	96,349
Burners	204	51,977	173	12,044	376	94,021
Others	92	37,651	89	66,247	181	103,898
Total	518	158,073	379	136,195	897	294,268

Uses of Combustor Capacity: The table below sets out the major combustor capacity by the categories of use as reported in the MFBI data.

IRON AND STEEL INDUSTRY MAJOR COMBUSTOR CAPACITY
BY USE (MMBtu/hr.)

	Major Gas Combustors		Major Non-Gas Combustors		Total	Percent
Use						
Electricity Generation	19,620	12.4%	4,508	3.3%	24,128	8.2%
Spaceheating	7,561	4.8%	4,402	3.2%	11,965	4.1%
Process Steam	14,866	23.1%	17,130	12.6%	51,996	17.7%
Other	96,024	60.7%	110,157	80.9%	206,179	70.0%
Total	158,073	100.0%	136,195	100.0%	294,268	100.0%

Approximately 70 percent of the major combustor capacity is used for purposes other than electricity generation, space

heating, or process steam. The major gas combustors exhibit a greater tendency to be used for electricity generation, space heating and process steam but these three categories of use account for only 19 percent of the capacity. The "other" category represents 61 percent of the major gas combustor capacity and 81 percent of the non-gas combustor capacity. An examination of iron and steel plants containing major gas combustors indicates the one most important use of combustor capacity use classified as "other" is reheating of steel. The table below sets out the specific uses of combustor capacity reported as "other" in the MFJI data.

SPECIFIC USES OF COMBUSTOR CAPACITY REPORTED AS OTHER THAN ELECTRICITY GENERATION, SPACE HEATING OR PROCESS STEAM FOR PLANTS CONTAINING MAJOR GAS COMBUSTORS

	Capacity MMBtu/hr.	Percent of Total	Percent of Specified
Use			
Reheating	44,042	24.9	65.5
Blast Furnace/Turbo Blowers	12,755	7.1	18.6
Open Hearth Production	4,867	2.7	7.1
Sintering	2,001	1.1	2.9
Heat Treatment	784	0.4	1.1
Coke Ovens	570	0.3	0.8
Blast Furnace Preheat	240	0.1	0.4
Miscellaneous	2,435	1.4	3.6
Unspecified	111,677	62.0	---
Total	180,171	100.0	100.0

Although only 38 percent of capacity reported as used for "other" purposes was identified by specific uses, these specific uses are probably representative of the industry. Reheating, which accounts for 65.5 percent of the specified uses, includes reheating ingots, slabs, blooms, and billets. After smelting, molten steel is poured into rectangular containers called ingot molds. After the steel solidifies, the ingot is removed from

the mold and placed in a soaking pit in preparation for hot rolling into slabs, blooms, and billets. Almost all slabs, blooms, and billets are processed through reheat furnaces as a step in the production of hot-rolled products. The most common base load fuels for ingot soaking pits are coke oven gas and blast furnace gas. The most common fuel for reheat furnaces is coke oven gas. Only small amounts of blast furnace gas are available for reheat furnaces because most of it is used in soaking pits and as boiler fuel. Natural gas and oil compete as supplements for coke oven gas in reheat furnaces. For specialty alloy and stainless steel natural gas is the preferred fuel in both soaking pits and reheat furnaces because it is free from sulfur.

The second most important use of natural gas in the iron and steel industry was reported in iron production. The specific applications are hydrocarbon injection and blast furnace preheat. With hydrocarbon injection natural gas, oil, coke oven gas, tar, or coal is introduced into the air blast. The hydrogen from these fuels reduces the iron oxide faster and permits increased production. Approximately one-third of the blast furnaces using hydrocarbon injection enrich the air blast with natural gas. Natural gas is well suited for this process since it can be injected with very simple equipment. In addition the use of natural gas requires no storage or preparation and substantially no maintenance.

A second application of natural gas in blast furnace operation is the preheat of combustion air for blast furnaces in regenerative stoves. Traditionally, blast furnace gas and coke oven gas were the primary fuels used for blast furnace preheat. However, the decline in the blast furnace coke rate (number of tons of coke required to produce a ton of iron) due to technological changes has reduced the supply of gas from these sources. Thus, there appears to be a trend toward increased

reliance on natural gas and other supplemental fuels for this application.

Blast furnace hydrocarbon injection and preheat account for 19 percent of the reported specific uses of natural gas in the other use category. The remaining specific uses reported account for approximately 12 percent of the other uses. These include open hearth production, sintering, heat treatment, and coke ovens. In open hearth steel production natural gas is used to heat the molten pig iron in a regenerative reverberatory furnace. Natural gas competes with oil in this application. Although up to 50 percent of the fuel used in an open hearth furnace can be natural gas, the remainder must generally be supplied by oil or tar to produce a flame of high luminousity.

Sintering is a process that improves the porosity and size distribution of the iron ore charged into blast furnaces. Iron ore fines, mill scale, flue dust, coke breeze and water are mixed and processed through a traveling-grate sintering furnace. The coke dust provides most of the energy required but blast furnace gas, coke oven gas or natural gas is required for ignition.

By-product coke oven gas and blast furnace gas usually provide the base load for the heat treatment of steel (annealing and quenching). Natural gas and oil compete as supplemental fuels on the basis of cost alone, although natural gas is the preferred fuel for heat treating stainless and some specialty steels.

Primary Fuel for Major Combustors: As shown below, the most important fuel source in the iron and steel industry is classified as "other". The major portion of these fuels

are by-product coke oven and blast furnace gas. To a lesser extent coke, propane and perhaps naphtha are included in this category. Coal ranks second in importance as a primary fuel and accounts for 33 percent of the total iron and steel major combustor capacity. Natural gas accounts for the primary fuel in 24 percent of the major combustor capacity, while residual and distillate fuel oils combined account for less than 7 percent. With respect to the major gas combustors, 65,838 MMBtu/hr. of capacity or 41.7 percent, reported gas as the primary fuel. Coal and other fuels account for 23.4 percent and 28.8 percent respectively, of the primary fuel of major gas combustor capacity, while residual and distillate combined account for 6.1 percent.

PRIMARY FUEL FOR MAJOR COMBUSTORS

	Major Gas Combustors (MMBtu/hr.)	Major Non-Gas Combustors (MMBtu/hr.)	Total (MMBtu/hr.)	(Percent)
Primary Fuel				
Gas	65,838		65,838	23.4
Residual	9,547	9,253	18,800	6.4
Distillate	180	350	530	0.2
Coal	36,938	60,540	97,533	33.1
Other	45,570	66,052	111,588	37.9
Total	158,073	136,195	294,368	100.0

Alternate Fuels for Major Gas Combustors: The table below sets out the alternate fuels for the major gas combustors with gas as the primary fuel. Overall, residual fuel oil is the most important alternate fuel for these combustors, accounting for 48.9 percent of the capacity. Coal was reported as the alternate fuel for 13.6 percent of the capacity, while distillate and other fuels were reported as alternate fuels for 10.1 percent and 4.7 percent of the capacity. Almost 23 percent of the major gas combustors burning gas as the primary fuel reported no alternate fuel capabilities. Of the total capacity with no alternate fuel, 17.9 percent is

attributed to boilers, 43.6 to burners, and 38.5 percent to other combustors.

ALTERNATE FUELS FOR MAJOR GAS COMBUSTORS
WITH GAS AS PRIMARY FUEL

Type of Combustors	Gas as Primary Fuel (MMBtu/hr.)	Alternate Fuels (Percent)					
		Residual	Distillate	Coal	Other	None	Total
Boiler	14,359	39.0	4.4	37.9	-	18.7	100.0
Burner	35,365	44.5	7.3	14.0	0.5	33.7	100.0
Other	16,109	58.6	16.0	-	3.5	21.9	100.0
Total	65,833	48.9	16.1	13.6	4.7	32.7	100.0

1974 Fuel Consumption of Major Combustors: As shown previously, other fuels, primarily blast furnace gas and coke oven gas, were reported as the primary fuel for 37.9 percent of the iron and steel industry major combustors. However, in the MFBI data the quantities and quality of these other fuels were not reported. The table below sets out the 1974 reported fuel consumption on an equivalent Btu basis. Since the table excludes other fuels, the consumption stated as percentages will necessarily overstate the dependence on natural gas, fuel oil, and coal. Based upon the reported primary fuels for combustor capacity natural gas, fuel oil, and coal account for an estimated 62 percent of total major combustor fuel consumption.

FUEL CONSUMPTION OF MAJOR COMBUSTORS, 1974 1/

Fuel	Billion Btu	Percent
Gas	451,037	39.2
Residual	145,016	12.7
Distillate	3,340	0.3
Coal	549,356	47.8
Total	1,149,747	100.0

1/ Excludes "other" fuels which account for an estimated 38 percent of total fuel consumption.

APPENDIX SCHEDULES

[illegible]

REGION I

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR[a] HPBI COMBUSTORS IN 1974
BY AQCR AND AQMA
(Billions of Btu's)

State AQCR -AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Connecticut					
Eastern CT	--	9,287.5	--	--	9,287.5
Hartford-New Haven-Springfield	969.0	7,372.5	47.0	--	8,388.5
-CT	969.0	7,372.5	47.0	--	8,388.5
NJ-NY-CT	--	8,739.5	--	--	8,739.5
-CT	--	8,739.5	--	--	8,739.5
Total	969.0	19,419.5	47.0	--	20,415.5
Massachusetts					
Hartford-New Haven-Springfield	967.0	4,196.7	--	130.0	5,663.7
-Springfield	967.0	4,366.7	--	130.0	5,663.7
Berkshire	196.0	1,471.6	--	--	1,701.6
Central	827.1	6,138.5	--	--	6,965.6
-Worcester	827.1	1,303.6	--	--	2,170.5
Metro Boston	1,905.3	10,319.0	--	--	12,661.0
-Boston	1,905.3	10,311.8	--	--	12,621.0
Metro Providence	96.0	392.3	41.0	--	530.1
Total	3,867.3	19,184.9	41.0	130.0	23,368.0
Maine					
Androscoggin Valley	--	11,069.3	--	--	11,069.3
Aroostook	--	6,447.0	--	--	6,447.0
Down East	--	28,199.6	--	--	28,199.6
Metro Portland	--	5,786.0	--	--	5,787.0
N.H. NH	--	5,888.8	--	128.0	6,016.8
Total	--	56,771.7	--	728.0	59,161.7
New Hampshire					
Androscoggin Valley	--	8,608.7	--	--	8,608.7
Merrimack Valley-S.NH	659.5	1,775.9	23.9	--	7,459.5
Central NH	--	--	11.8	--	11.8
Total	659.5	8,384.7	35.5	--	9,079.0
Rhode Island					
Metro Providence	--	1,790.7	--	--	1,790.7
-Metro Providence	--	1,790.7	--	--	1,790.7
Total	--	1,790.7	--	--	1,790.7
Vermont					
Champlain Valley	96.0	--	151.9	--	205.9
VT (Remaining Area)	--	--	47.0	--	47.0
Total	96.0	--	198.9	--	252.9
TOTAL REGION I	**5,592.8**	**107,552.5**	**322.5**	**728.0**	**120,195.7**

a/ Major combustors are those individual combustors within an HPBI with a design firing rate of 100 MMBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION II

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR a/ NSPS COMBUSTORS IN 1974
BY AQCR AND AQMA
(Billions of Btu's)

State AQCR -AQMA	Oil (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
New Jersey					
NJ-NY	7,433.3	68,895.1	3,044.3	--	80,183.0
-NJ-NY	2,952.1	68,896.1	1,560.8	--	80,189.6
Metro Philadelphia	5,881.6	55,901.3	--	--	61,386.7
-Metro Philadelphia	5,881.6	55,901.3	--	--	61,386.7
NJ (Remaining area)	370.3	1,023.6	117.5	112.0	1,623.5
-Ocean	370.3	1,023.6	117.5	112.0	1,623.5
NE, PA-Upper Delaware Valley	847.7	2,144.3	--	--	2,992.0
-Allentown-Bethlehem-Easton	--	178.7	--	--	178.7
Total	14,350.5	88,049.1	3,017.0	112.0	105,681.6
New York					
NJ-NY-CT	2,197.3	9,035.6	300.2	--	11,937.9
-NJ-NY	2,197.3	9,036.6	300.2	--	11,937.9
Central NY	--	4,210.8	117.7	13,000.0	20,316.3
-Syracuse	--	735.0	--	13,612.0	14,347.0
-Utica-Rome	--	1,002.3	--	86.0	1,088.3
Champlain Valley	--	10,320.1	--	226.0	10,750.1
Genesee-Finger Lakes	166.2	6,203.1	--	14,698.0	21,067.3
-Rochester	166.2	6,203.1	--	13,736.0	20,103.3
Hudson Valley	--	23,610.7	--	9,600.0	33,214.7
-Capital District	--	10,605.0	--	--	10,605.0
-Mid-Hudson	--	965.0	--	--	965.0
Niagara Frontier	2,102.5	10,736.0	33.3	5,818.0	18,723.7
-Niagara Frontier	2,056.5	10,736.0	33.3	5,818.0	18,723.7
Southern Tier E.	--	2,081.8	29.5	--	2,081.3
-Binghamton	--	--	29.5	--	29.5
Southern Tier W.	--	--	61.8	--	61.8
Total	8,669.0	73,093.0	587.0	66,090.0	107,000.1
TOTAL REGION II	23,019.5	161,142.1	3,604.0	66,202.0	212,967.0

a/ Major combustors are those individual combustors within an NFSI with a design firing rate of 100 mmBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION III

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR[a] UTILITY COMBUSTORS IN 1975
BY AQCR AND AQMA
(Billions of Btu's)

State AQCR -AQMA	Gas	Residual	Distillate	Coal	Total
D.C.					
National Capital	--	3,197.0	1,053.1	8,138.0	12,388.1
-National Capital	--	3,197.0	1,053.1	8,138.0	12,388.1
Total	--	3,197.0	1,053.1	8,138.0	12,388.1
Delaware					
Metro Philadelphia	1,155.2	9,197.3	3,866.5	--	13,182.2
S. DE	--	4,036.3	--	--	4,036.3
Total	1,155.2	14,230.0	3,866.5	--	19,250.7
Maryland					
National Capital	--	1,021.5	33.0	--	1,054.5
-National Capital	--	1,021.5	33.0	--	1,054.5
Central MD	--	344.9	--	1,920.0	2,264.9
Cumberland-Keyser	9,497.3	6,061.9	729.1	3,504.0	19,792.3
-Potomac River	9,497.3	6,061.9	729.1	3,504.0	19,792.3
Metro Baltimore	7,315.5	6,877.3	491.1	68,797.0	83,481.1
-Baltimore	7,315.5	6,877.3	491.1	68,797.0	83,481.1
S. MD	--	1,369.0	--	--	1,369.0
Total	13,873.2	18,666.9	1,185.2	80,220.9	111,726.0
Pennsylvania					
Metro Philadelphia	10,675.4	49,813.3	1,371.9	23,610.0	85,060.9
-Metro Philadelphia	10,675.4	49,813.3	1,371.9	23,610.0	85,060.9
S.E. PA-Upper Delaware Vly.	1,911.8	9,291.0	260.6	47,013.0	58,476.7
-Allentown-Bethlehem-Easton	--	9,161.1	91.0	38,063.0	47,315.1
S.W. PA-Youngstown	6,305.3	--	102.5	17,700.0	24,107.8
-Erie	3,350.0	--	102.5	7,197.0	10,649.5	
Central PA	1,955.3	--	110.0	69,196.0	71,261.3
-Johnstown	382.9	--	--	33,808.0	34,190.9
S. Central PA	9,137.9	4,200.7	1,184.8	7,550.0	22,073.4
-Harrisburg	1,681.7	838.1	--	--	2,519.8
-Lancaster	331.0	974.5	--	--	1,305.5
-York	333.9	694.0	--	99.0	1,126.9
S.W. PA	99,096.7	1,315.1	270.9	1,900.0	102,582.7
-Allegheny County	8,815.7	24,806.5	1,170.7	97,957.0	132,749.9
-Beaver Valley	9,530.9	17,017.0	787.6	88,222.0	115,557.5
-Monongahela Valley	3,005.0	7,060.1	197.1	18,806.0	29,068.2
		3,030.0			3,030.0
Total	91,958.5	98,001.9	6,787.1	201,918.0	187,674.5
Virginia					
Northern Central	--	88.0	88.0	1,330.0	1,506.1
-Northern Central	--	88.0	88.0	1,330.0	1,506.1
Central VA	2,301.5	817.2	88.0	8,402.0	11,608.9
-Fredricksburg	882.0	307.6	88.0	2,310.0	3,587.6
Hampton Roads	330.0	13,277.0	78.0	3,186.0	17,870.1
-Hampton-Newport News	330.0	4,588.2	--	--	4,988.2
-Norfolk-Portsmouth	--	--	--	--	--
Virginia Beach	--	1,079.0	--	--	1,079.0

a/ Major combustors are those individual combustors within an AQMA with a design firing rate of 100 MBtu/hr, or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION III

TOTAL OVERALL FUEL CONSUMPTION OF MAJOR[a] HPWR COMBUSTORS IN 1974
BY AQCR AND AQMA

(Billions of Btu's)

State AQCR AQMA	Coal (1)	Residual (2)	Distillate (3)	Gas (4)	Total (5)
Virginia (continued)					
N.E. Va.	--	11,709.5	--	--	11,709.5
Metro Capitol	9,784.0	14,753.8	1,918.6	470.0	31,880.4
-Petersburg, Colonial Hts.-Hopewell	1,784.0	9,790.3	1,918.6	470.0	21,880.4
-Richmond	--	4,973.5	--	--	4,973.5
Valley of Va	3,188.8	8,518.1	338.7	15,438.0	83,530.5
Total	8,881.5	52,417.4	4,182.0	65,308.0	133,809.9
West Virginia					
Huntington-Ashland-Portsmouth-Ironton	884.0	--	28.8	--	312.8
Parkersburg-Marietta	4,730.8	8,458.8	--	19,008.0	32,181.5
Steubenville-Weirton-Wheeling	1,468.5	3,778.2	--	13,118.0	20,203.8
Eastern Panhandle	--	765.2	--	5,106.0	5,811.7
Kanawha Valley	9,882.2	7,388.8	--	26,372.0	48,123.0
S. WVA	231.0	--	8.1	8,038.0	8,263.1
Total	16,986.1	13,148.1	36.9	82,632.0	112,389.1
TOTAL REGION III	31,837.1	188,831.1	10,788.8	137,808.0	181,385.1

a/ Major combustors are those individual combustors within an HPWR with a design firing rate of 250 MMBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

SECTION IV

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR[a] FUEL COMBUSTORS IN 1973
BY AQCR AND AQMA

(Billions of Btu's)

State AQCR AQMA	Coal	Residual	Distillate	Gas	Total
Alabama					
Birmingham & Tuscaloosa					
Alcoa	3,939.0	814.0	101.0	4,732.0	9,607.0
Columbus (Ga.)-					
Phenix City	4,280.0	19,371.0	--	--	23,651.0
S. Ala.	3,935.0	720.0	1,101.0	--	5,756.0
-Gadsden	2,676.0	307.0	0.0	--	2,983.0
Metro Birmingham	10,913.0	191.0	--	27,100.0	38,197.0
-Birmingham	17,350.0	595.0	--	50,184.0	68,916.0
Mobile-Pensacola-					
Pensacola City-S.Ms.	8,030.0	12,042.0	--	7,770.0	28,600.0
-Mobile	8,180.0	11,387.0	--	7,176.0	26,814.0
Tenn. R. Valley-					
Cumberland Mts.	1,780.0	9,473.0	--	19,838.0	31,191.0
Total	67,681.0	68,837.0	2,260.0	53,898.0	190,355.7
Florida					
Mobile-Pensacola-					
Pensacola City-S.Ms	20,187.0	19,703.0	0.0	--	39,177.0
Jacksonville-Brunswick	1,183.0	21,895.0	110.0	--	23,188.0
-Jacksonville	--	7,762.0	--	--	7,762.0
S.E. Fla.	4,324.0	5,488.0	10.7	--	9,822.0
W. Central Fla.	3,843.0	5,168.4	1,280.0	--	9,291.4
-Lakeland-Winter					
Haven	4,933.0	3,981.0	--	--	8,914.0
-Tampa-St. Petersburg	858.0	3,998.0	4,288.0	--	9,144.0
Total	31,158.4	68,996.0	5,688.0	--	97,840.1
Kentucky					
Parish-Celina	5,889.0	333.7	884.1	4,892.0	10,998.8
Evansville-Owensboro-					
Henderson	2,186.6	84.1	--	--	2,271.1
Louisville	8,180.1	881.0	883.0	16,380.0	27,784.1
-Louisville	8,180.1	881.0	883.0	16,380.0	27,784.1
Metro Cincinnati	844.0	--	--	1,896.0	2,696.0
Bluegrass	782.4	--	58.6	--	841.0
Huntington-Ashland-					
Portsmouth-Ironton	4,738.0	4,222.2	--	188.0	9,847.8
Total	13,336.0	3,498.7	766.1	20,488.0	37,180.1
Georgia					
Columbus-Phenix City	--	8,188.0	--	--	8,188.0
Jacksonville-Brunswick	867.1	11,188.0	--	--	12,388.1
Augusta-Aiken	1,186.1	8,848.0	1,811.0	--	11,845.1
Central GA	8,888.0	788.0	88.6	--	9,888.6
Chattanooga	8,781.1	881.0	--	1,188.0	3,888.0
Metro Atlanta	2,888.0	88.1	1.0	8,888.0	16,181.0
-Atlanta	1,888.0	--	1.0	818.0	2,188.1
S.E. GA	888.0	181.1	--	--	1,188.1
Savannah-Beaufort	11,881.0	13,118.0	--	--	24,888.0
-Savannah	18,818.0	17,887.1	--	--	31,118.0
S.W. GA	8,781.1	6,181.0	88.1	8,888.0	11,888.1
-Albany	788.8	8.8	88.1	--	888.8
Total	82,181.6	88,884.8	1,188.8	18,888.8	83,892.8

a/ Major combustors are those individual combustors within an AQMA with a design firing rate of 100 MBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION IV

TOTAL OVERALL FUEL CONSUMPTION OF MAJOR[a] FOSSIL COMBUSTORS IN 1974
BY AQCR AND AQMA
(Billions of Btu's)

State AQCR AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Mississippi					
Memphis-Tennessee:					
Panama City, Fla.	39,890.1	39,840.6	1,561.6	8,668.0	88,841.7
Mississippi Delta	17,978.2	68.5	--	--	18,046.8
N.E. MS	--	85.0	--	--	85.0
Total	54,868.3	39,967.3	1,561.6	8,668.0	84,765.2
North Carolina					
N. Piedmont	1,622.0	3,118.5	4,087.3	6,658.0	15,830.7
-Greensboro	466.7	1,354.5	--	--	1,821.2
-Winston-Salem	--	--	4,087.3	6,858.0	8,285.7
S. Mountain	--	--	96.1	--	96.1
S. Piedmont	1,811.0	2,101.0	187.0	6,858.0	9,016.1
Metro Charlotte	1,436.0	2,311.6	--	2,108.0	5,853.6
-Charlotte	87.0	311.0	--	--	58.1
N. Coastal Plain	--	11,973.6	--	--	11,973.6
Sandhills	2,063.6	702.3	844.8	--	2,990.5
S. Coastal Plain	2,178.0	39,868.6	--	9,918.0	51,364.6
W. Mountain	1,376.8	2,585.1	28.4	13,412.0	17,102.3
Total	11,573.5	63,690.5	6,883.1	87,990.0	87,429.6
South Carolina					
Augusta-Aiken	3,663.6	1,169.3	--	10,838.0	17,301.9
Savannah-Beaufort	316.5	91.1	--	--	458.6
Metro Charlotte	6,038.1	6,899.6	--	7,844.0	18,781.5
Camden-Sumter	1,329.0	130.7	878.6	3,136.0	3,181.0
Charleston	8,338.6	10,175.9	--	--	18,514.1
-Charleston	282.6	8,618.2	--	--	8,900.8
Columbia	1,116.0	113.6	--	--	1,229.6
Florence	1,705.0	3,396.9	--	1,188.0	6,289.9
Greenville-Spartanburg	1,882.9	1,211.9	--	--	3,094.8
-Greenville	87.0	281.6	--	--	368.6
Greenwood	86.0	--	--	1,016.0	1,098.0
Georgetown	--	7,672.6	--	--	7,672.6
Total	23,301.3	38,882.0	878.6	24,208.0	86,867.7
Tennessee					
Tennessee R. Valley-Cumberland Mts.	--	--	--	2,016.0	2,016.0
Metro Memphis	10,882.8	892.0	892.0	--	13,867.1
Chattanooga	2,389.0	638.6	706.1	4,186.0	7,919.5
-Chattanooga	2,389.0	638.6	706.1	4,186.0	7,919.5
E. TN	13,715.9	1,877.0	629.0	27,836.0	43,836.5
Middle TN	8,875.6	845.7	4,268.7	14,148.0	28,067.8
-Nashville	3,339.7	--	888.0	8,888.0	8,139.7
W. TN	1,892.0	888.8	88.7	--	3,844.4
Total	39,814.8	6,878.8	8,810.8	78,894.8	132,318.4
TOTAL REGION IV	133,818.8	481,183.4	18,734.8	418,888.8	843,484.4

a/ Major combustors are those individual combustors within an AQMA with a design firing rate of 100 10⁶Btu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION V

TOTAL OVERALL FUEL CONSUMPTION OF MAJOR a/ NFSI COMBUSTORS IN 1974
BY AQCR AND AQMA
(Billions of B.t.u's)

State AQCR -AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Illinois					
Quincy-Keokuk	1,078.6	817.4	810.3	6,312.0	9,018.3
-Peoria	1,008.8	--	810.3	6,312.0	8,134.6
E. Central IL	1,372.0	99.4	2,598.6	7,000.0	11,031.0
Metro Chicago	69,360.0	17,062.8	1,968.9	15,761.0	104,152.7
-IL-IN-WI	67,637.1	17,062.8	1,968.9	13,662.0	100,330.8
Metro Dubuque	2,000.0	--	--	--	2,000.0
Metro Quad Cities	9,298.3	1,674.8	--	888.0	11,857.1
Metro St. Louis	13,599.6	29,489.9	33.3	3,158.0	46,280.8
-St. Louis	13,599.6	29,489.9	33.3	3,158.0	46,280.8
N. Central IL	5,591.1	183.3	184.6	4,002.0	9,779.7
Paducah-Cairo	61.0	--	0.8	2,222.0	2,278.8
Rockford-Janesville-Beloit	--	--	--	848.0	848.0
S.E. IL	1,918.4	8,199.7	67.1	877.0	11,237.1
W. Central IL	9,804.0	310.3	33.3	2,664.0	13,811.6
-Peoria	8,804.0	310.3	33.3	2,664.0	11,811.6
Total	96,200.8	57,861.5	6,565.3	56,036.0	216,661.6
Indiana					
Metro Chicago	76,163.4	32,080.8	--	173,668.0	301,870.0
- IL-IN-WI	76,163.4	32,080.8	--	173,666.0	301,870.0
S. Central IN	1,879.8	998.7	11.9	3,046.0	5,313.8
Evansville-Owensboro-Henderson	1,499.0	--	--	33,176.0	34,603.9
- Evansville Interstate	--	--	--	788.0	788.0
Louisville	830.0	--	36.8	3,185.0	4,130.8
- Louisville	830.0	--	36.8	3,366.0	4,230.8
Metro Cincinnati	893.0	--	--	778.0	1,671.0
Metro Indianapolis	361.0	930.0	--	3,812.0	5,103.1
- Indianapolis	361.0	930.0	--	3,912.0	5,103.1
N.E. IN	--	888.7	--	2,158.0	3,333.7
S. Bend-Elkhart-Benton Harbor	1,596.0	863.3	9.8	1,344.0	3,809.6
N.IN	1,117.6	--	--	1,990.0	3,107.6
Wabash Valley	2,244.4	4,184.0	847.8	8,882.0	16,178.2
Total	81,974.7	39,180.2	999.7	234,268.0	361,962.6
Michigan					
Central MI	8,428.7	3,863.9	60.9	21,138.0	33,291.5
Metro Detroit-Port Huron	76,526.9	5,602.6	150.1	71,190.0	101,867.6
-Detroit	76,526.9	5,602.6	150.1	71,190.0	101,867.6
Metro Toledo	--	--	--	6,632.0	6,632.0
-Toledo	--	--	--	6,632.0	6,632.0
S. Central MI	17,778.0	3,752.8	--	5,062.0	26,791.5
Upper MI	11,156.3	188.8	382.7	14,286.0	25,943.8
Total	113,883.9	13,194.7	573.7	117,308.0	244,178.4

a/ Major combustors are those individual combustors within an NFSI with a design firing rate of 100 MMBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

Section V

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR a/ NFSI COMBUSTORS IN 1974 BY AQCR AND AQMA

(Billions of Btu's)

State AQCR -AQMA	Coal (1)	Residual (2)	Distillate (3)	Gas (4)	Total (5)
Minnesota					
Fosston IRR	430.0	--	--	86.0	516.0
S.E.MN-La Crosse	2,100.0	960.4	0.0	--	3,060.4
Duluth-Superior	49,375.0	869.5	476.7	1,788.0	52,061.4
Fargo-Moorhead	--	--	--	1,116.0	1,116.0
Minneapolis-St. Paul	9,481.0	2,431.3	88.0	510.7	12,302.3
-Minneapolis-St. Paul	9,393.0	2,431.3	88.0	510.0	12,822.3
N.W. MN	870.0	--	--	1,884.0	2,603.0
S.W. MN	398.0	30.7	--	--	834.7
Total	28,382.0	1,981.6	562.6	5,310.0	38,196.2
Ohio					
Metro Cincinnati	25,716.7	2,278.5	2,067.5	11,528.0	50,588.7
-Cincinnati	24,714.7	2,278.5	2,067.5	11,528.0	40,588.7
Huntington-Ashland-Portsmouth-Ironton	3,710.7	964.9	680.6	2,068.0	10,180.8
Metro Toledo	8,883.1	2,180.6	--	4,500.0	15,333.7
-Toledo	8,883.1	2,180.6	--	4,500.0	15,333.7
Dayton	2,056.9	5.9	603.1	4,600.0	23,125.9
-Dayton	2,056.9	5.9	603.1	20,460.0	23,125.9
Greater Metro Cleveland	26,270.6	33,035.6	476.8	20,460.0	110,287.6
-Akron-Canton	6,612.3	25,789.2	83.1	61,916.0	39,500.6
-Cleveland	19,658.3	7,246.2	393.7	39,146.0	60,717.0
Mansfield-Marion	1,903.0	1,502.5	66.0	12,770.0	16,203.5
-Mansfield	1,900.0	1,502.5	--	12,770.0	16,203.5
Metro Columbus	3,320.2	361.0	253.0	8,680.0	12,572.2
-Columbus	3,320.2	361.0	137.1	1,944.0	5,958.2
S.W. OH	3,320.2	361.0	137.1	256.0	4,062.3
W.W. PA-Youngstown	10,267.7	376.0	161.8	5,080.0	15,885.5
-Youngstown	12,305.5	7,511.5	--	61,426.0	81,242.7
Parkersburg-Marietta	12,305.5	7,511.5	--	61,426.0	81,242.7
Zanesville	710.0	--	93.5	16,476.0	18,279.5
Steubenville-Weirton-Wheeling	3,311.7	66.6	66.8	7,960.0	11,344.8
-Steubenville	5,648.7	--	1,208.8	88.0	6,884.1
Wilmington-Chillicothe-Logan	5,648.7	--	1,208.8	88.0	6,884.1
Zanesville-Cambridge	--	--	936.0	8,484.0	9,140.8
Total	4,228.8	--	127.3	4,336.0	8,688.6
	107,087.9	58,923.5	5,188.7	219,950.0	383,348.1
Wisconsin					
Rockford-Janesville-Beloit	885.0	--	--	884.0	1,169.0
S.E.WI-La Crosse	182.0	305.5	--	660.0	1,307.5
Lake Michigan	12,129.9	1,363.1	671.9	8,540.0	22,686.5
-Lake Michigan	11,031.7	208.1	160.3	8,540.0	19,951.7
N. Central WI	8,368.1	2,721.6	671.8	11,030.0	31,792.1
S.E.WI	5,865.4	61.6	783.0	709.0	7,838.7
-IL-IN-WI	5,865.4	61.6	783.0	72.0	7,838.7
S.WI	4,869.8	--	855.8	1,010.0	6,815.6
Total	33,850.8	4,991.5	1,879.0	58,186.0	97,918.1
TOTAL Section V	419,388.1	181,038.8	13,583.8	819,870.0	1,273,880.1

a/ Major combustors are those individual combustors within an NFSI with a design firing rate of 100 MMBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

TOTAL ANNUAL FUEL CONSUMPTION OF
MAJOR[a] COMBUSTORS IN 1977
BY AQCR AND AQMA
(Billions of Btu's)

State AQCR AQMA	Gas	Residual	Distillate	Coal	Total
Arkansas					
Central AR	23,162.0	10,095.3	--	--	33,258.3
Little Rock	18,134.0	4,175.6	--	--	22,309.6
Metro Fort Smith	979.0	--	--	--	979.0
Metro Memphis	--	22.1	--	--	22.1
Monroe-El Dorado	5,153.0	4,377.1	155.0	--	10,685.1
S.E. AR	4,730.0	--	674.0	--	5,404.0
Shreveport-Texarkana-Tyler	4,430.0	4,474.0	58.0	--	8,964.0
Total	40,087.0	19,092.1	891.0	--	60,671.1
Louisiana					
Baton Rouge	23,311.0	3,735.0	115.1	--	27,160.0
Shreveport-Texarkana-Tyler	10,197.0	2,272.0	58.0	510.0	12,837.0
Shreveport	9,496.3	2,272.0	--	510.0	12,278.3
S.E. LA-S.W. MS	426,018.0	27,706.0	189.0	--	453,913.0
Total	469,197.1	35,885.1	532.1	510.0	506,124.3
New Mexico					
AB-NM-S Border	2,735.9	2,179.1	--	--	4,915.1
Albuquerque-Rio Rio Grande	5,535.5	12.5	11.9	--	5,559.9
Albuquerque	2,867.3	12.5	11.9	--	2,891.9
Total	8,268.4	2,192.0	11.9	--	10,810.4
Oklahoma					
Metro Fort Smith	982.0	16,825.7	--	--	17,867.7
Shreveport-Texarkana-Tyler	3,991.0	3,991.0	20.0	--	7,134.0
Central OK	1,774.7	--	61.2	--	1,781.5
Central OK	1,726.7	--	61.2	--	1,787.5
E. Central OK	11,566.1	--	81.9	--	11,156.0
N.E. OK	10,810.1	22.1	1.8	--	10,834.7
Tulsa	10,710.1	22.1	--	--	10,766.0
S.W. OK	1,813.6	--	--	--	1,813.9
S.E. OK	1,320.1	--	--	--	1,320.1
S.C. OK	2,196.1	--	--	--	2,886.1
Total	47,366.1	19,836.8	115.8	--	67,118.7
Texas					
Shreveport-Texarkana-Tyler	23,121.0	22.1	--	--	23,143.1
E. Central TX	200,001.3	12.6	1,365.9	--	201,181.3
Abilene	213,334.0	12.6	680.1	--	206,257.3
El Paso-Las Cruces	1,673.7	2,003.1	--	1,062.0	7,006.9
El Paso	1,673.7	2,003.1	--	1,364.0	7,006.9
Abilene-Wichita Falls	701.7	--	--	--	701.7
Amarillo-Lubbock	57,851.7	180.1	31.9	--	58,111.7
Austin-Waco	7,667.0	801.6	80.1	29,600.0	33,110.1
Brownsville-Laredo	4,086.0	--	837.6	--	4,923.6
Corpus Christi-Victoria	93,054.7	821.9	810.1	--	95,726.1
Corpus Christi	70,761.7	801.1	810.1	--	73,400.9
Metro Dallas-Fort Worth	17,196.7	1,119.7	15.8	15.0	18,139.2
Dallas-Fort Worth	16,307.7	1,119.7	15.8	15.0	17,457.4
Metro Houston-Galveston	637,391.3	16,563.7	870.7	5,100.0	579,165.9
Galveston	103,000.0	--	--	--	103,000.0
Houston	533,850.7	16,563.7	870.7	5,100.0	476,765.1
Metro San Antonio	8,561.7	--	--	--	8,561.7
San Antonio	8,561.7	--	--	--	8,561.7
Midland-Odessa-San Angelo	83,630.4	--	--	--	83,630.4
Total	889,430.9	20,155.7	3,100.5	31,630.0	1,004,636.3
TOTAL REGION VI	1,353,484.5	96,761.5	7,653.3	32,270.0	1,870,169.4

a/ Major combustors are those individual combustors within an AQCR with a design firing rate of 100 MBtu/hr, or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION VII

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR[a] HPBI COMBUSTORS IN 1974
BY AQCR and AQMA
(Billions of Btu's)

State AQCR -AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Iowa					
Burlington-Keokuk	6,761.0	--	84.5	1,104.0	7,929.5
Metro Dubuque	929.0	--	--	528.0	1,457.0
-Dubuque	929.0	--	--	528.0	1,457.0
Metro Quad Cities	7,736.0	25.2	647.2	13,030.0	21,438.4
-Davenport	601.4	--	--	6,160.0	6,761.4
Metro Sioux City	3,257.7	--	100.0	--	3,357.7
N.E. IA	6,315.0	1,617.0	749.9	1,698.0	9,379.9
-Cedar Rapids	2,806.0	1,617.0	749.9	77.0	5,252.9
-Waterloo	2,491.7	--	--	1,676.0	4,167.7
N. Central IA	1,219.6	--	97.8	2,784.0	4,099.4
S. Central IA	5,762.5	188.2	61.8	2,310.0	7,326.4
-Des Moines	4,232.3	144.1	83.8	2,310.0	6,769.6
Total	29,956.7	1,830.4	1,930.7	21,466.0	55,183.3
Kansas					
Metro Kansas City	8,769.9	2,876.1	90.7	210.0	11,976.7
-Kansas City	8,769.9	2,876.1	90.7	210.0	11,976.7
S.E. KS	498.0	96.5	35.0	--	629.5
N. Central Kansas	2,793.2	--	--	--	2,793.2
S.W. KS	1,179.0	133.2	--	--	1,312.2
S.E. KS	6,252.3	--	--	1,444.0	7,697.3
S. Central KS	6,888.5	302.4	--	--	7,190.9
Total	26,981.9	3,408.1	125.7	1,654.0	31,707.7
Missouri					
Metro St. Louis	7,056.5	311.0	60.6	9,838.0	17,266.0
-St Louis	7,056.5	311.0	60.6	9,838.0	17,266.0
Metro Kansas City	10,672.5	3,707.7	255.9	706.0	15,342.0
-Kansas City	10,672.5	3,707.7	255.9	706.0	15,342.0
N. MO	349.0	134.1	60.6	12,829.0	13,370.7
S.E. MO	531.0	--	--	8,832.0	9,361.0
S.W. MO	1,605.0	--	--	--	1,605.0
Total	20,215.7	4,152.8	385.2	32,005.0	56,733.7
Nebraska					
Omaha-Council Bluffs	3,308.0	183.8	32.9	--	3,524.7
-Omaha-Council Bluffs	3,308.0	183.8	32.9	--	3,524.7
Lincoln-Beatrice-Fairbury	5,230.0	--	111.5	--	5,339.5
NE Interstate	3,431.2	347.5	--	3,616.0	7,390.7
Total	11,969.2	531.3	190.3	3,616.0	16,286.8
TOTAL REGION VII	87,893.3	9,940.8	2,599.5	58,736.0	159,983.3

a/ Major combustors are those individual combustors within an HPBI with a design firing rate of 100 MMBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION VIII

TOTAL FOSSIL FUEL CONSUMPTION OF
MAJOR[a] HCFCI COMBUSTORS IN 1974
BY AQCR AND AQMA
(Billions of Btu's)

State/ AQCR -AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Colorado					
Metro Denver	10,197.1	13,001.1	876.7	864.0	24,938.9
-Metro Denver	10,197.1	13,001.1	876.7	864.0	24,938.9
Pawnee	1,998.3	738.2	--	1,170.0	3,906.5
-N. Central CO	2,147.3	191.7	--	1,170.0	3,519.0
San Isabel	8,438.8	871.6	--	25,576.0	37,886.4
-Colorado Springs	707.6	--	--	--	707.6
-Pueblo	2,638.8	638.4	--	17,664.0	23,108.1
Total	31,978.7	15,607.0	876.7	30,580.0	77,417.4
Montana					
Billings	2,693.0	2,267.1	--	--	4,960.1
-Billings	2,693.5	2,267.7	--	--	4,920.2
Great Falls	199.1	--	--	--	199.1
Helena	11,117.8	--	--	--	11,117.8
-Anaconda-Butte	7,253.6	--	--	--	7,253.6
-Helena	1,888.9	--	--	--	1,888.9
Miles City	867.8	539.2	--	--	1,407.0
Missoula	1,291.0	--	--	--	1,291.0
-Missoula	1,291.0	--	--	--	1,291.0
Total	16,919.8	2,796.9	--	--	19,716.8
North Dakota					
N.D. Interstate	868.5	2,093.9	--	1,512.0	4,364.4
Total	868.5	2,093.9	--	1,512.0	4,364.4
South Dakota					
Metro Sioux Falls	805.0	193.5	--	26.0	824.5
-Sioux Falls	805.0	193.5	--	26.0	824.5
Total	805.0	193.5	--	26.0	824.5
Utah					
UT (exc. Wasatch and Four Corners Area)	2,087.2	--	--	1,548.0	3,635.2
-N. Central UT	1,866.6	--	--	380.0	2,246.6
-S.E. UT Coal Resource	--	--	--	416.0	416.0
Wasatch Front	25,815.0	2,859.6	11.5	30,038.0	61,533.9
-Salt Lake City	14,344.0	1,865.2	--	8,328.0	23,537.2
-Provo	11,481.0	1,994.4	--	22,896.0	36,371.4
Total	27,902.2	5,859.6	11.5	31,586.0	65,969.6
Wyoming					
Casper	2,291.2	127.0	--	--	2,418.2
Metro Cheyenne	1,671.3	10.8	--	1,020.0	2,702.1
WY (Remaining area)	23,161.9	13,451.1	1,200.0	2,560.0	39,714.0
-Sweetwater	19,717.7	14,337.8	1,200.0	2,560.0	35,104.3
Total	27,115.9	13,591.6	1,200.0	3,580.0	45,048.0
TOTAL REGION VIII	105,590.1	39,933.0	2,088.2	67,284.0	214,340.1

a/ Note: combustors are those individual combustors within an HCFCI with a design firing rate of 100 MBtu/hr or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION IX

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR a/ MFBI COMBUSTORS IN 1976
BY AQCR AND AQMA

(Billions of Btu's)

State AQCR AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Arizona					
Arizona-S. Nevada-S. Border	10,430.6	1,150.0	--	--	11,870.6
Clark-Mohave	--	--	--	27.0	27.0
Four Corners	2,166.1	260.2	541.0	440.0	3,787.9
Phoenix-Tucson	14,315.3	1,373.9	4,531.0	--	20,220.2
-Phoenix	710.6	122.8	--	--	833.4
-Tucson	4,208.2	1,339.8	110.9	--	5,658.9
Total	29,812.7	2,956.0	5,073.0	662.0	38,503.7
California					
Metro Los Angeles	53,990.7	10,819.3	1,369.3	1,890.0	68,078.8
-S. Coast	53,990.7	10,819.3	1,369.3	1,890.0	68,078.8
N. Cent Cl Coast	3,781.0	1,585.6	--	--	5,367.6
N. Coast	--	535.9	--	--	535.9
Sacramento Valley	6,408.1	58.1	--	--	6,466.1
-Sacramento Valley	2,578.6	--	--	--	2,578.6
San Diego	75.0	--	6.5	--	80.5
-San Diego	75.0	--	6.5	--	80.5
San Francisco Bay	71,697.5	2,565.7	159.6	--	74,697.0
-San Francisco Bay	71,353.5	2,985.1	159.6	--	74,697.0
San Joaquin Valley	33,511.2	5,004.3	33.2	716.0	39,354.7
-Fresno County	1,190.5	--	33.2	--	1,213.7
-Kern County	6,535.0	4,870.9	--	726.0	10,131.9
-San Joaquin & Stanis-laus Counties	5,808.1	91.1	--	--	6,899.2
-Tulare County	106.0	--	--	--	106.0
S. Central Coast	684.2	201.6	--	--	784.8
S.F. Desert	15,810.2	11,690.1	139.1	264.0	16,903.4
-S.F. Desert	14,701.0	11,088.3	--	266.0	15,167.3
Total	185,711.3	33,190.1	1,697.7	3,660.0	213,269.1
Nevada					
Clark-Mohave	117.3	573.0	--	--	691.3
S.W. NV	1,788.0	--	--	--	1,788.0
NV (Except Clark-Mohave and SW NV)	--	624.3	--	3,100.0	3,724.3
Total	3,105.3	1,197.1	--	3,100.0	6,600.6
TOTAL REGION IX	218,629.3	37,133.2	6,969.7	6,208.0	263,180.1

a/ Major combustors are those individual combustors within an MFBI with a design firing rate of 100 mmBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

REGION 8

TOTAL FOSSIL FUEL CONSUMPTION OF MAJOR 1/ OPSD COMBUSTORS IN 1974
BY AQCR and AQMA
(Billions of Btu's)

State AQCR AQMA	Gas (1)	Residual (2)	Distillate (3)	Coal (4)	Total (5)
Idaho					
E. ID	3,660.0	--	--	670.0	4,330.0
E. WA-E. ID	6,197.4	82.6	--	--	6,280.0
ID Interstate	317.9	61.1	99.1	2,194.0	2,672.1
Metro Boise	580.5	--	--	1,580.0	2,060.5
Total	9,756.5	143.5	99.1	5,314.0	15,194.1
Oregon					
Portland OR	--	1,081.5	--	--	1,081.5
E. OR	1,082.9	--	87.5	3,358.0	3,529.3
N.W. OR	150.1	370.0	--	--	1,520.1
Portland	13,503.0	4,029.7	810.8	--	17,743.5
-Eugene-Springfield	890.9	494.1	--	--	1,385.0
-Portland-Vancouver	3,902.8	1,102.1	81.0	--	5,125.9
S.W. OR	--	1,863.7	--	--	1,863.7
Total	14,639.0	8,530.0	307.3	3,358.0	26,826.4
Washington					
E.WA-E. ID	1,709.2	11.8	71.6	990.0	2,781.6
-Spokane	472.6	--	--	--	472.6
Portland	10,366.5	8,833.2	50.4	--	19,250.0
-Portland-Vancouver	4,902.9	2,760.9	60.6	--	7,724.3
Olympic-N.W. WA	18,013.8	13,700.2	3.8	200.0	31,918.3
Puget Sound	15,117.1	5,869.8	282.9	168.0	21,436.8
-Puget Sound	14,630.3	3,967.1	282.9	168.0	18,828.3
S. Central WA	4,897.8	1,301.3	93.8	1,136.0	6,361.7
Total	51,016.5	29,916.3	499.4	1,994.0	91,986.6
TOTAL REGION 8	83,168.3	31,823.9	788.8	11,306.0	127,987.4
TOTAL LOWER 48 STATES	2,870,040.0	1,127,830.7	88,214.8	1,278,168.0	5,363,853.5

a/ Major combustors are those individual combustors within an MPSI with a design firing rate of 100 MBtu/hr. or greater. All such combustors are included herein, regardless of whether or not they have ever consumed gas.

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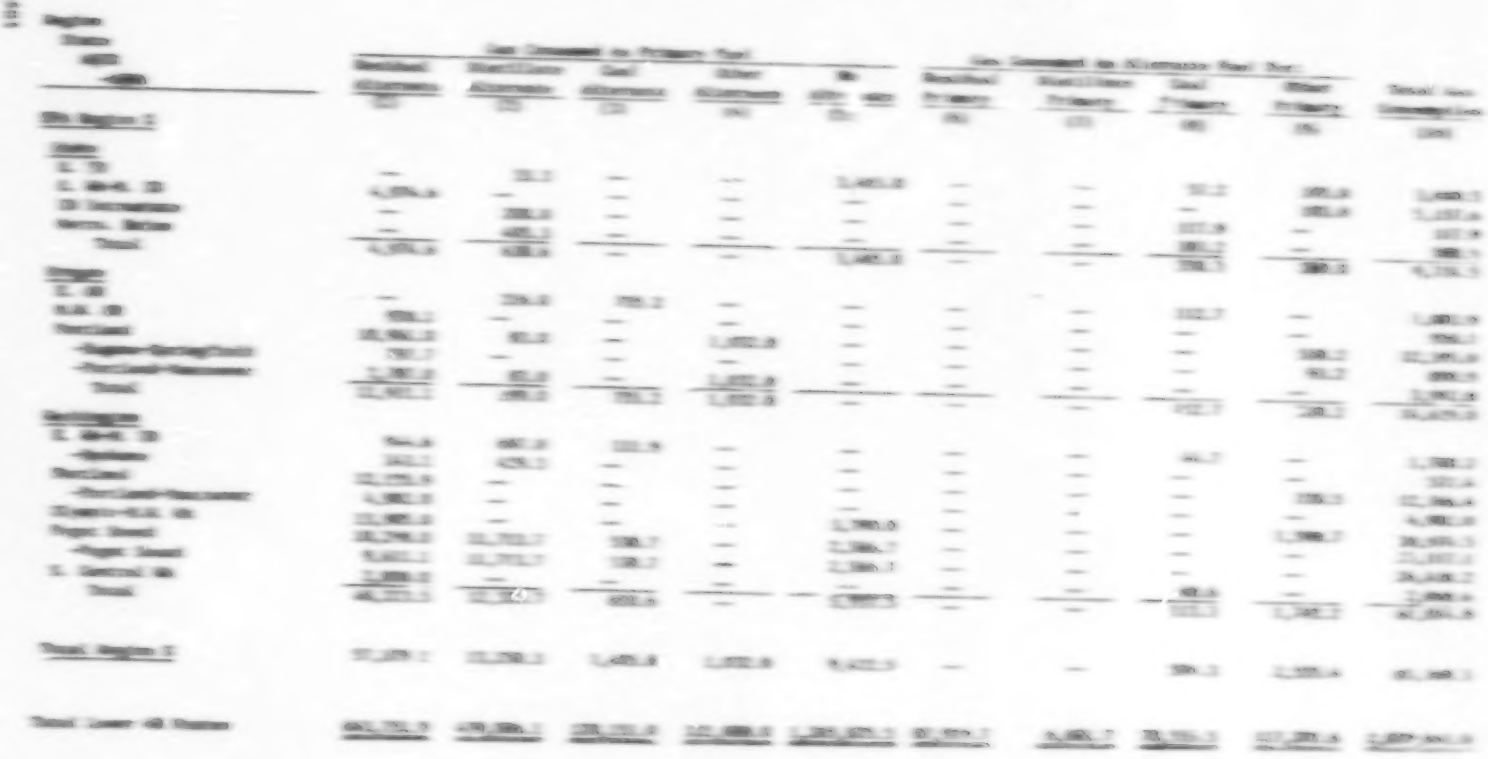

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/3-77-017c	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE: Impact of Natural Gas Shortage on Major Industrial Fuel Burning Installations - Volume III. Appendix: Summary and Analysis of Fuel-Burning Characteristics of MFBIs		5. REPORT DATE: March 1977
7. AUTHOR(S): Brickhill, J. A.		8. PERFORMING ORGANIZATION CODE
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16. ABSTRACT

This study was conducted to analyze the impact of natural gas shortages on major fuel burning installations. The analysis consisted of the review of gas curtailments plans, natural gas supplies, FEA survey data for MFBI and applicable state air pollution control regulations. This analysis estimated the availability of natural gas through 1980 for major fuel burning installations, the alternate fuel burning capability of these plants, the need for alternate fuels such as fuel oil and coal to offset the gas shortages and the estimated increase in sulfur dioxide and particulate emissions from the burning of these alternate fuels. The study results are presented in a three volume report: the first contains the narrative for the analysis of natural gas shortages on the gas fired plants with pertinent findings and conclusions; the second contains schedules or data summaries for the natural gas fired plants; and the third presents a limited analysis of all the MFBI data.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Fuels Natural gas curtailments Steam plants United States Government Regulations Air Pollution Combustion Sulfur dioxide Particulates	Natural gas Fuels Air pollution control Stationary sources Non-Utility sources	

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